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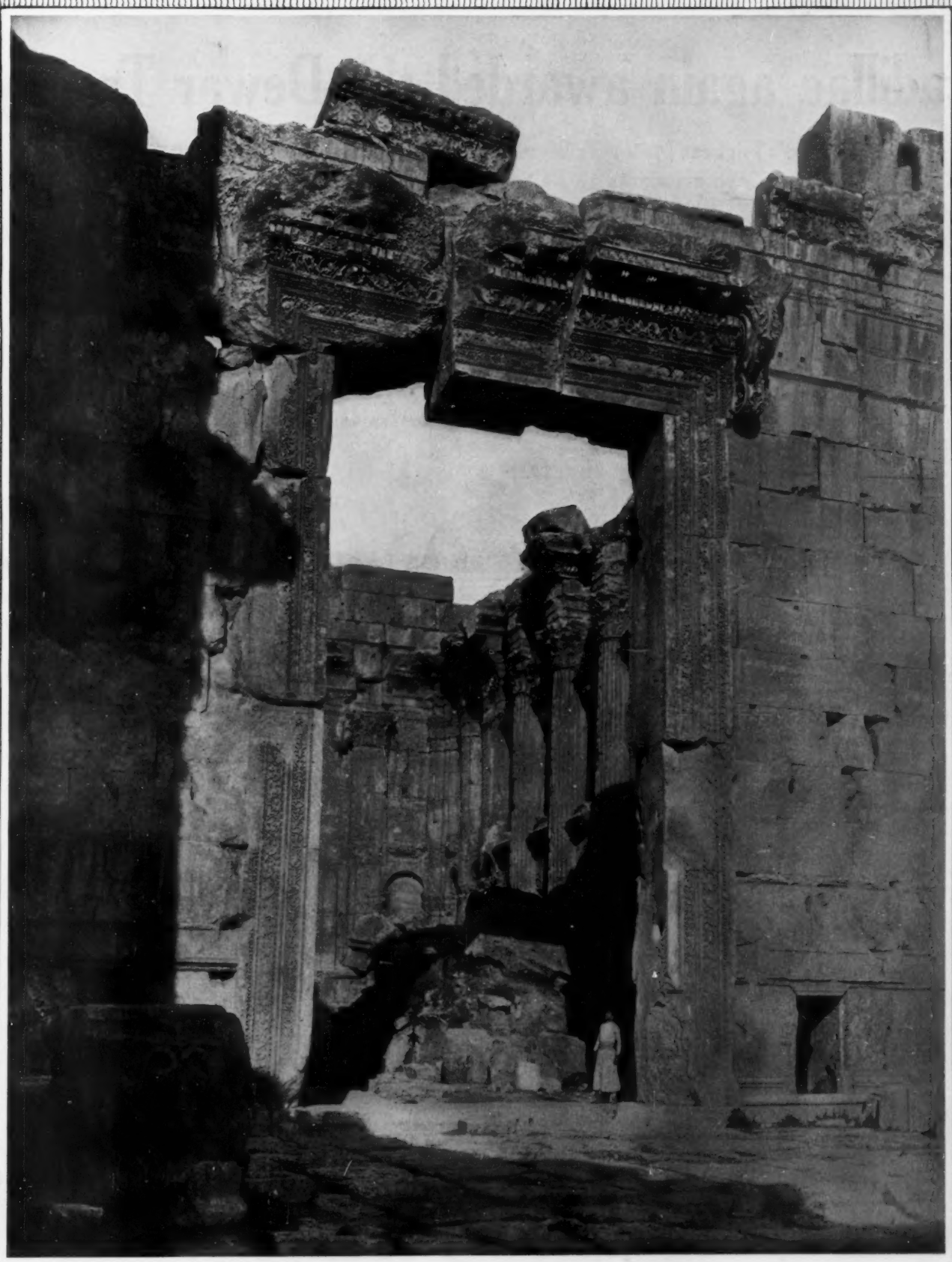
SCIENTIFIC AMERICAN



DOORWAY OF THE TEMPLE OF BACCHUS, BAALBEK

Vol. CIX. No. 24
December 13, 1913

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

Cadillac
Standard of the World

Cadillac again awarded the Dewar Trophy

Europe's Highest Motor Tribunal pronounces 1914 Cadillac mechanical achievements to be greatest of the year, demonstrating the advancement of the industry

In our first announcement of the 1914 Cadillac, and its two-speed direct drive axle, we said:—"The Cadillac is about to endow the motor car with A new element of efficiency, A new quality of luxury, A new source of economy."

After several thousand purchasers had received demonstrations of the truth of this prediction, we said in a later announcement:

"Motoring as you know it, and motoring as the owner of a 1914 Cadillac knows it, are two distinct and different things."

And we added, that the Cadillac owner was enjoying luxuries to which you must remain a stranger as long as you did not drive a Cadillac.

But we did not dream when we wrote the words, that so distinguished an endorsement as the second award of the Dewar Trophy was close at hand.

You will recall that the first award of the Dewar Trophy to the Cadillac pronounced it the most thoroughly standardized car in the world.

In the test, three Cadillac cars were entirely dismantled, all of the parts thoroughly mixed, and eighty-nine parts removed from the heap and substitute parts provided.

The three cars were then re-built into perfect running condition from the haphazard heap—wrenches and screw drivers being the only tools necessary.

Standardization was defined to mean in this test—as it always has meant—that every Cadillac part was exactly like every other part of its kind.

It did not mean nearly like it or almost like it, but absolutely like it, down to the one-thousandth part of an inch, where that degree of accuracy was essential.

In other words, that there was complete interchangeability, perfect alignment of parts and units, perfect harmony in their operating relations with each other, and a total absence of ill-fitting joints and bearings.

The Cadillac is the only car which has ever passed this tremendously significant test of what constitutes standardization; and the award to the Cadillac was the only one ever made upon such a test.

And that fact lends especial significance to this second award of the same trophy to the same car, but from a new angle of analysis.

It is one thing to feel sure that your manufacturing principles are sound and scientific.

THE DEWAR TROPHY

It is another, and a more pleasant thing, to have that fact almost universally appreciated by your own countrymen.

But it is gratifying in the extreme to have the approval of your own nation reinforced by an international verdict.

You, as a Cadillac owner—present or prospective—can take just pride in this second award of the Dewar Trophy.

It is more than a Cadillac achievement—it is a tribute from high sources to American skill and to American engineering initiative.

The Royal Automobile Club, which conducts the contests for the Dewar Trophy, is the most conservative tribunal of its type in the world.

The Dewar Trophy is the motor classic.

It is awarded for the most distinguished achievement of the year, demonstrating the advancement of the industry.

It takes into account manufacturing principles as well as performances.

Sir Thomas Dewar, when he instituted the Trophy, had it in mind to seek out, each year, the car of super-excellence.

So the awards are as disinterested, and as scientific, as the awards of the Nobel Prize in a totally different field of endeavor.

We may all of us feel justly reinforced, therefore, in our good opinion of this splendid American car, the Cadillac.

We may feel that its virtues have not been overstated.

We may all feel that these announcements have not overdrawn the advantages of the latest Cadillac development, the Cadillac two speed direct drive axle.

It was not merely the point-by-point performance of the car over give-and-take roads for a thousand miles.

It was not merely the certainty and the endurance of the electrical devices in self-cranking, lighting and ignition.

It was not merely the remarkable record of 17.17 miles per gallon of gasoline (notwithstanding repeated stops and starts in testing the electric cranking device).

It was not alone the astonishing record of more than 1,000 miles per gallon of lubricating oil.

It was not only that the two-speed direct drive axle was a material factor in making possible these results; and that it gave to the word "luxury" a new meaning as applied to motoring.

It was not only the perfect record in the shifting of the rear axle gears from high to low and vice versa 520 times, by means of the electric shifting device.

No, the Dewar Trophy was awarded to the Cadillac for the second time—and the Cadillac is the only American car which has ever received it, and the only car in the world to which it has ever been awarded twice—because the Cadillac is the Cadillac, because it is what it is, and because it does what it does.

Because the Cadillac proved itself to be the car of all-around super-excellence as a complete entity.

Because it proved its dominant characteristics to be those which make most for all-around constancy and serviceability.

Because, as we have said, no other car rides or drives like the Cadillac.

Because, in fact, it is the Standard of the World.

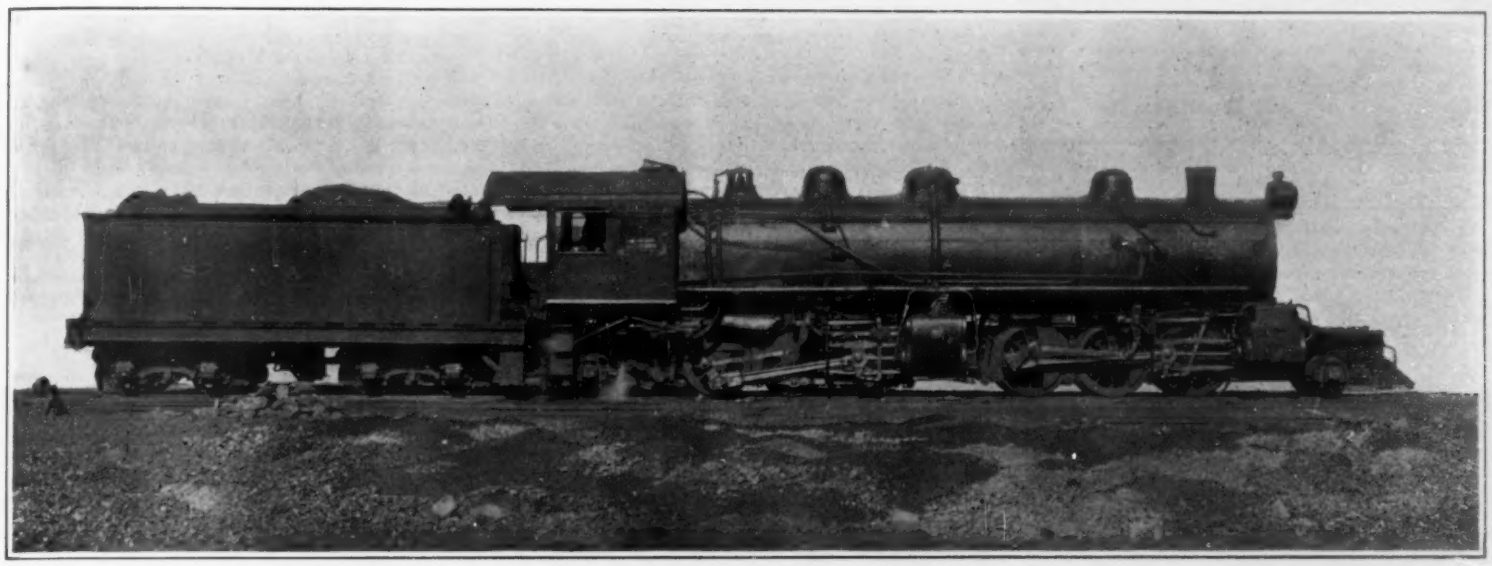
Cadillac Motor Car Co. Detroit, Mich.

SIXTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CIX. NUMBER 24.] NEW YORK, DECEMBER 13, 1913. [PRICE 10 CENTS $3.00 A YEAR



Mallet-type locomotive fitted with mechanical stoker; built for experimental purposes.

Stoking the Locomotive by Machine

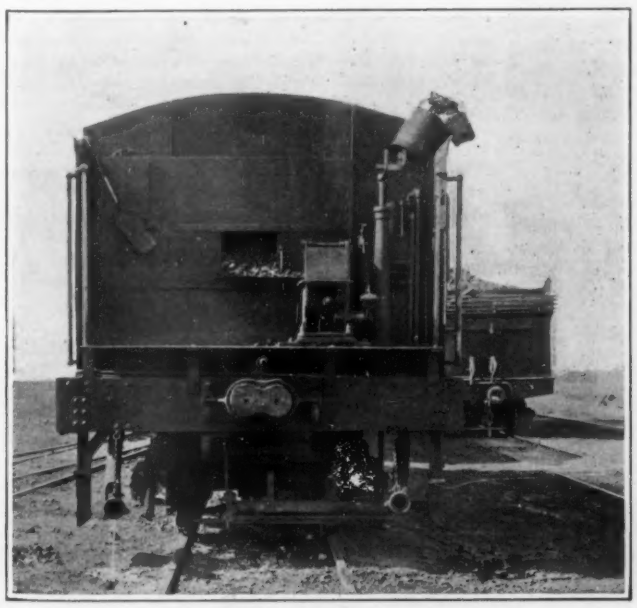
A Large American-built Mallet-type Locomotive for South Africa

THERE has recently been introduced on the Union of South African railways a large 2-6-6-2 Mallet type locomotive, built from the designs of Mr. D. A. Hendrie, the chief mechanical engineer of the South African railways, to serve experimental purposes. The engine works on the compound system, and has no superheater, while the driving coupled wheels of the high and low pressure engines are of different sizes (3 feet 10 inches and 4 feet 3 inches diameter, respectively), in order to increase the hauling capacity on the heavy gradients. The engine has a total heating surface of 33,385 square feet with a grate area of 49.5 square feet and a tractive force at 50 per cent cut-off, of 45,200 pounds. The wheel-base of the engine is 41 feet 6 inches, and the total wheel-base of engine and tender 66 feet 9 inches, while the total length is 74 feet 10¼ inches and the height from rail level to chimney stack is 12 feet 10⅞ inches. In working order the engine weighs 103 tons 2 hundredweight and the tender 50 tons 17 hundredweight.

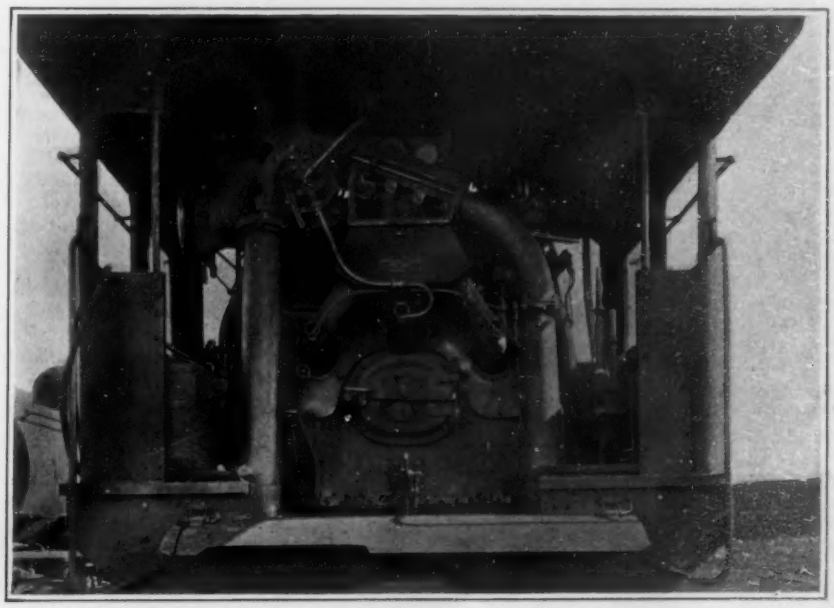
The most interesting feature in this Mallet type of locomotive is its equipment with the "Street" mechanical stoker, the salient features of which are shown in the pictures at the bottom of the page. The tender is of the ordinary type, carried upon two 4-wheel trucks. It has a carrying capacity of 4,000 gallons of water and 10 tons of coal. The tender is fitted with a crusher of the moving jaw type, worked by an engine placed behind the brake pillar. The fireman shovels the coal into the hopper of the crusher, which reduces it to a uniform size. The coal falls from the crusher, through a chute, into a receiver fitted behind the drawbar of the locomotive, whence it is picked up by buckets working on a belt in the pipe and is discharged into the central hopper on the firebox above the firehole door, The buckets rise full on the left-hand side, and are worked by another small engine placed on the top of the firebox on the left-hand side.

There are three delivery pipes from the central hopper to the inside of the firebox. The delivery of the coal is controlled by three steam cocks operated by adjustable cams on the main shaft of the auxiliary engine, and can be directed, by means of a conical tray, either to the middle or to the right or left coal-feeding pipe, whence the fuel is blown into the firebox by the steam jets, the force of which is regulated by the cams, so as to deposit the coal just where it is required.

While it is premature to discuss the merits or otherwise of this stoker, it is claimed to have given better results, so far as locomotives are concerned, than any that have yet come under notice. It is undoubtedly a complicated machine, the fireman having to attend to two auxiliary engines in addition to handling the same amount of coal. Of course the labor of shoveling from the tender into the firebox is avoided, but every ounce of coal burned has to be transferred by hand to the crusher. A very noticeable feature of this device is the noise. First there is the crusher working at a rapid rate, next the circulation of the conveyor belt, and finally the Maxim gunlike reports of the steam cocks controlling the feeding, which all tend to contribute to produce a racket that is deafening to one who is unaccustomed to the working of the machine.



Forward end of tender showing the coal crusher.



Rear view of the locomotive showing the pipes which feed the furnace with coal.

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Scientific American in the Schools and Universities

OF the material which comes daily to the Editor's desk, not the least interesting and valuable is the correspondence of what might be called a personal character which deals in a critical way with the subject matter that appears in our columns. Only an editor realizes how difficult it is to keep in close touch with the needs and tastes of his readers; and certainly none knows better than he how great is his desire at all times to gather just the kind of information which is desired, and present it in a manner which shall be at once illuminating and agreeable. The aim and scope of the SCIENTIFIC AMERICAN is stated exactly in the opening italicized words of our editorial columns: "The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement."

Occasionally our readers are moved to write and tell us how far, in their judgment, we are succeeding in our task as thus set forth; and always these comments are welcome, and always the suggestions which have practical value are noted and, as far as may be, followed.

We have been much gratified at the widespread interest which has been awakened by our recent contest relative to the Ten Greatest Inventions of the past quarter of a century. We have received many letters from widely scattered localities and from people in diversified walks of life. Thus the professor of English at one of our universities writes us: "The Freshman English in the School of Mining and Engineering of this university has been in my charge for some time. At present I have nearly one hundred students enrolled in this class. In looking about for an interesting subject to begin the year's course, I noticed the contest you have been conducting in regard to the ten most important patentable devices. I asked the class to write papers on this subject and to select the one device which might be considered the most important. It may interest you to know that I received more papers on the subject of the wireless telegraph than on any other invention."

As showing that the SCIENTIFIC AMERICAN cannot be straying very far outside of the lines which it has laid down for itself, we quote again from the same correspondent: "I have required the students to select some technical magazine for reading during the year, to enable them to keep in touch with the present state of progress in the field in which they intend to carry on their life work. Out of the one hundred students enrolled in the Freshman English class, forty-three express their preference for the SCIENTIFIC AMERICAN. We shall have monthly reports of the leading articles in your paper, followed by some class discussion on the material thus presented."

Apropos of the above we publish the following extract from a letter received from the vice-principal of a high school in California: "May I express a word of appreciation for the great help which I constantly get from the SCIENTIFIC AMERICAN in my work as a science teacher? My laboratory is equipped with a balopticon with which we can project opaque material. I find your journal the best available source for good illustrations on live topics in all branches of high school science. Nearly all of the pictures can be readily projected as they stand, but where details need to be brought out or the cut is too dark, it is an easy matter to retouch them. Why would it not be a paying proposition for you to feature such work for schools? An increasingly large number of schools are equipping for opaque projection work, and I am sure that the large army of teachers and students of science among your readers will gladly welcome anything which will make their work easier and more efficient."

Another correspondent writes us: "I have read with much interest the matter in your current issue relative to the ten greatest inventions, and it seems to the writer that the result of your efforts is worthy of a more permanent presentation, from an educational standpoint, than the series of essays will attain; therefore I tender you this suggestion." Our correspondent goes on to propose that plates suitable for framing should be prepared, both of the inventors and of their principal inventions, and that these should be used to decorate the walls of classrooms in our public and high schools, taking the place of the less appropriate illustrations with which these walls are covered, and in some cases disfigured.

Now, although it does not come within the province of such a journal as ours to do work of the kind suggested, our correspondent has raised a question which we commend to the school boards throughout the country. In an age so thoroughly scientific and technical as this, the average mural decorations in our public and high schools are sadly lacking in that appropriateness and deep interest which modern facilities make it so easy to provide.

Twenty-five-knot Battleships

WE have been requested by a correspondent to give some description of the latest type of British battleship of 25 knots speed. In some respects these are the most remarkable fighting ships of modern times; for they combine with the speed of the cruiser a battery of guns of exceptional size and power. The programme of the British navy for the year 1912-1913 called for five battleships of what is known as the "Queen Elizabeth" class. Not much has been published about these ships, nor is it generally understood what remarkable vessels they will be. It is our opinion that they will not be repeated in later classes; and indeed it is stated that already the British Admiralty have decided to return to a ship of smaller displacement and more moderate speed in their programme of construction for the next year. The "Queen Elizabeth," according to information published in British technical journals, is 640 feet in length over all, which brings the ship, at least so far as her length is concerned, into the cruiser class. Her displacement is to be 28,000 tons. The ship is to be equipped with Parsons turbines capable of developing about 50,000 horsepower, and this, in view of the great length and fine model of the ship, is expected to give her a speed under ordinary conditions of 25 knots, which, as everyone will recognize, is something altogether unprecedented in a battleship.

The armament also marks a great departure from existing practice. She is to carry eight 15-inch guns mounted in four two-gun turrets, all placed, according to the American system, on the longitudinal center line of the ship. The 15-inch piece is a most powerful weapon. It weighs 96 tons and fires a projectile weighing 1,950 pounds. How great an advance this is will be understood by comparing its dimensions with that of the 13.5-inch gun, mounted on the latest ships of the British navy, which fires a projectile of 1,400 pounds. The weight of the 15-inch gun is 96 tons, as against a weight of 76 tons for the 13.5-inch gun. The muzzle velocity is not high, being only 2,500 feet per second, but the muzzle energy is over 84,000 foot-tons.

The armor protection will be just under 14 inches for the water-line belt and somewhat heavier on the turrets, slightly exceeding in this respect our own "Nevada" and "Oklahoma," which hitherto have been the most heavily protected ships in any navy. The "Queen Elizabeth" and her four sister ships will carry a secondary battery of sixteen, fifty-caliber 6-inch guns, and she will also mount guns for protection against airship attack from above. We are not surprised to learn that this class of ship will not be repeated in the British navy. The large amount of weight which must be allotted to the motive power, in order to secure 25 knots, might better be given to the armor protection or guns. This would be in line with the policy which we have steadily, and as we believe very wisely, followed in our own navy, where the speed is moderate and the armor and armament very powerful.

Universal Time Keeping

THE achievement of regular wireless communication between the station on the Eiffel tower in Paris and the naval radio tower at Arlington, Virginia, transmitting time signals between the two stations, marks an important stage in the progress of accurate determinations of longitude. For a number of weeks experiments were conducted in the transmission of these signals before satisfactory results were attained, but after interference from other apparatus was eliminated, and atmospheric conditions became favorable, it was found practicable to maintain coincident beats between the clocks of the Paris and the Washington observatories for several minutes. This result was reached on November 20th, 1913, a date which may well be compared with September 18th, 1764, when John Harrison demonstrated the successful operation of his chronometer.

The joint work of the French and American commissions for the determination of longitude will now go forward with increased efficiency, and a higher degree of precision in the determination of many positions may be expected, to say nothing of the possibilities for the development of greater accuracy in navigation.

It was long understood that differences in longitude, being proportional to differences in time, needed only precise and accurate timepieces for the solution of this most practical problem. Newton urged the necessity for the development of a reliable chronometer, but it was not until Harrison produced his instrument that a definite commercial device was offered. It is generally understood that the principal improvement in timepieces introduced by Harrison was that of the compensating balance, enabling temperature errors to be reduced to a minimum, but it is believed that another point was developed by him which is of much wider importance than appears in its use with the chronometer. Ordinarily it was assumed that the great thing to be attained was a timepiece which should have a very small error, or in other words, a watch which should keep very good time. The navigator, carrying such a watch would always have with him the time of a definite position, such as Greenwich Observatory, and by determining his local time by observations upon the sun or stars he could thus find the difference in longitude between his own position and that of Greenwich, allowing fifteen degrees for every hour, or one degree for every four minutes of time difference.

Harrison knew, what every instrument maker now realizes, that it is impracticable to make an instrument which shall be without error, but he also appreciated the most important fact that while he could not make an errorless instrument, he might make one of which he could make an exact determination of the error, which was just as good. He thus set himself about to make a watch, not to keep absolutely correct time, but to have a uniform rate of error. A chronometer which loses precisely two seconds a day is as good as one which does not lose at all, since the correction of two seconds for every day enables the correct reading to be made for every day of the voyage. Since Harrison's time the chronometer has been much improved, but the reduction in the time of voyages has also made the necessity for long time corrections less necessary. Since modern vessels carry several chronometers, any serious deviation from the uniform rate is readily detected, and the unreliable instrument eliminated.

The most interesting example of longitude determination by the use of the chronometer is associated with another scientific development which was far from being appreciated until long years afterward. When the "Beagle" left England, in December, 1831, her commander, Captain, afterward Admiral Fitzroy, was the prominent scientist on board, and the principal equipment of the ship was supposed to be the twenty-seven chronometers, carefully rated; the voyage being undertaken principally to determine the longitude of numerous islands and other points in the south Atlantic and Pacific.

The important work thus accomplished has been somewhat overshadowed by the fact that the young naturalist of the expedition, Charles Darwin, whose work was practically an afterthought, employed his opportunities so well that the appearance of the Origin of Species, twenty-five years later, is usually coupled with the idea of the voyage of the "Beagle."

With the development of the electric telegraph the determination of differences in longitude of places between which wires could be run, became a simple operation, since the velocity of time communication became so great as to supersede the less accurate method of carrying timepieces bodily between the various points; and repetition and reversal of signalling enabled errors to be eliminated from this method.

As soon as the Atlantic cable was put into successful operation its applicability for the determination of time differences between points in Europe and America became evident, and so the work has gone on, until now the methods of radio-telegraphy are being drawn into service.

While the difference in longitude between Paris and Washington is already sufficiently well known for all practical purposes, the establishment of a regular wireless time service, covering the wide areas served by the Paris and the Arlington stations will enable numerous stations in the West Indies, in Central America, and in South America, to be equally well served, and these, in turn, will serve their various territories.

Engineering

Semaphores Regulate Street Traffic.—Experimental tests have been made this fall in Chicago of a semaphore signal for the control of street traffic at the crossings. The semaphore is broadly similar to those used in railroad service. It is operated by the policeman on duty at the crossing and it can be seen fully a block away. There should be a future for this device, especially at the intersection of the busiest main thoroughfares of congested cities.

Government Protects Naval Secrets.—The United States Government has brought suit against the E. W. Bliss Company, which owns the patent for the Bliss-Leavitt torpedo in France, Japan and England. The company wishes to give the details of its system to Whitehead & Co. of England. The United States Government, insisting that it owns a proprietary interest in the torpedo, is seeking to prevent this disclosure.

Engineering Reducing Corrosion in Pipes.—It is observed that the gases which water holds in solution have a marked effect upon the wear of iron and steel tubes, and if the oxygen is eliminated, the internal corrosion of piping is lessened to as much as one tenth part in certain cases. Following this method the hot water piping used for central heating systems can be protected and will last much longer. At the top of the hot water pipes is mounted an air separator of suitable design which serves to remove the dissolved air. This is found to be very efficient.

Substituting a Steel Railroad Bridge in Five Minutes.—A steel bridge was recently removed and replaced by another, near Victor, N. Y., on the Lehigh Valley Railroad, in the remarkably short space of under five minutes; and this was done without any delay in the traffic. The new bridge which was put in place complete, even to its ballasted tracks, is a plate-girder structure, with a span of 103 feet. The main girders are 10 feet high, and it has a solid concrete floor. This mass was rolled into place in three minutes and was ready for immediate use. The old bridge was rolled out of the way in a minute and three quarters.

Feed Water Heating.—The new Brooke high velocity feed water heaters are claimed to deliver water 20 degrees hotter than the usual heaters, and gain a considerable saving of fuel. When working with exhaust steam it is known that heaters find a difficulty in delivering water hotter than 170 to 180 deg. Fahr. when working at maximum capacity. With the new system this can go as high as 200 deg. Fahr. Such heaters are made in vertical and horizontal types and work equally well on live and exhaust steam, a very economical arrangement being to have an exhaust and a live steam heater working in conjunction.

Steam Meter.—It is a well-known fact that a large amount of steam is wasted in many plants, and as this waste occurs in ways which cannot easily be detected, it would be of value to have an efficient steam meter. This is also useful for plants which deliver steam for different purposes in a works, in order to reckon the cost in each department. The new Curnon steam meter is now proving to be quite a benefit to steam users. It operates by means of a small plug inserted in the steam piping which carries bent tubes placed in the path of the steam, these being connected by small pipes to a chart recorder. The recorder itself can be placed at any reasonable distance from the steam piping.

To Record Aeroplane Vibrations.—The vibrations which are produced by machines can be recorded upon a drum by well-known devices; but when it comes to recording the vibrations of an aeroplane framework which is in movement in the air and thus has no fixed point of support, the matter is much more difficult. A recent apparatus made by the Duc de Guiche consists of a small air chamber covered by a diaphragm which is weighted by a heavy disk. The inertia of the metal disk serves instead of a fixed point, so that the air chamber transmits the different air pressures due to vibrations, by a flexible tube, to a second diaphragm chamber, provided with a metal point which makes a record on a drum. We expect to describe this device.

A Ten Thousand Seven Hundred Ton Auxiliary Sailing Ship.—Another of those large and handsome sailing ships which remind us that the days of sail power are not altogether passed, has been launched by the Société Anonyme des Chantiers et Ateliers de la Gironde, Bordeaux. She is a five-masted ship, carrying a sail spread of 70,000 square feet. Her length is 430 feet, beam 55 feet 9 inches, depth 28 feet 2 inches, loaded draught 24 feet, and when loaded her displacement is 10,700 tons. The ship has the large carrying capacity of 6,500 tons. Under sail spread in strong winds, this ship is capable of making 16 knots or over. She is fitted also with Schneider-Carels-Diesel oil engines of 900 shaft horse-power, which are estimated to give the ship a speed of 10 knots.

Electricity

Gloves for X-ray Work.—The protecting gloves which are generally in use for X-ray work are ordinary gloves having applied on the back a layer of lead-containing rubber, as lead is known to stop the rays. But this layer is somewhat stiff and lacks suppleness, and besides it is only the back of the hand that is protected and the palm and sides which are often exposed to the rays have no such shield from their action. A French inventor makes use of a fabric which is much more flexible and it protects the whole of the hand from injury by the rays. The new fabric is woven from silk which is heavily "sized" with a lead composition, so that it contains three times its weight of lead. This tissue has the advantage of being much more elastic than that which has been used up to the present, and acts as a very good screen for the X-rays, especially when the back portion is reinforced. It will no doubt render good service to operators, who always run the risk of severe burns.

Electrical Protection of Ships' Hulls.—That the corrosion of the exterior of ships' hulls is very largely due to electrolytic action is pretty extensively recognized. The joined plates, immersed in sea water, form so many battery cells owing to the chemical dissimilarity of the plates, and in each such cell the positive plate becomes pitted. It is well known that boilers, condensers and the like may be protected against electrolysis tending to destroy them by attaching plates of zinc in their interiors, since by the electro-negative relation of the iron of the boiler or condenser to the zinc the latter is corroded and the iron rendered immune from corrosion. The new method of protection of the hull is to make the latter electro-negative to a specially disposed iron anode set in the hull in contact with the sea water. The special anode or anodes, insulated from the hull, are connected to an electric generator the other pole of which is grounded on the hull. In this way the destructive action of the sea water is directed to the anodes alone; and the merit of the idea lies in the fact that these anodes are easily and cheaply renewed when necessary.

Generator of Record Size.—While we are familiar with large alternators for use with steam turbines of 25,000 horse-power, and there are several projects on foot for machines of as high as 40,000 horse-power, the size of continuous current generators has not followed the recent progress in designing large machines. This is due to difficulties of construction inherent in this class of dynamo, especially as regards commutation. A machine recently built in France is of 4,400-kilowatt capacity, which appears to be the record for size. It was built at the extensive works of the Société Alsacienne at Belfort and will soon be running at the central plant of the Longwy Steel Works. The machine is a generator on the 3-wire system with 480 volts maximum, and furnishes a current of 9,170 amperes, working at a standard of 94 revolutions per minute. Of the usual multipolar type, the field has 24 poles and also a set of commutation poles. Exterior diameter of this giant machine is about 18 feet and the total weight 86 tons. The rotating part weighs 38 tons. The present generator is to be coupled direct upon a gas engine. A second machine of the same kind is now under construction.

Diesel Engine for Electric Generators.—The use of different kinds of prime movers for driving electric generators has also led to special designs of dynamos in order to operate under the best conditions. For instance, when the steam turbine came into use, an appropriate form of dynamo was the result, differing from what was used with the steam engine. Now that the Diesel crude oil engine is largely in use as a source of power, a re-design of dynamos is a natural consequence, for the working conditions of the gas or oil engine differ from what prevails in the steam engine. In fact the turning moment of such engines is not as uniform as that of the steam engine, and it is also necessary to compensate for occasional back-fires. A greater flywheel effect is thus necessary than for a steam engine with the same number of cranks, especially when it comes to running alternators in parallel. In general engine practice the alternator is mounted on the engine shaft so as to make a compact group, but to increase the flywheel effect of the rotor as desired for the Diesel engine would mean a heavier rotor in case of dynamo of small diameter, or if the rotor is given a large diameter this unduly increases the size of the alternator. The Oerlikon works overcome the difficulty by an original design which consists of mounting an outer rotating field upon the engine shaft next to the engine so as to form the flywheel, this part being cup-shaped or overhanging, and inclosing the inner fixed armature which is mounted on a side bracket foundation plate placed at the outer side along with the bearing, this design resembling the familiar form used as a horizontal machine for hydraulic turbines. As the outer field carries a heavy rim to make up the flywheel, it is seen that as the rotating part is now on the outside it affords a greater wheel effect for a given diameter of dynamo. Such Diesel groups are built up to 1,500 horse-power size.

Science

Col. W. C. Gorgas, U. S. A., famous for his sanitary achievements in Cuba and Panama, has been invited to advise on sanitary conditions at Johannesburg, South Africa.

A Natural History Reserve in Tunis.—It is reported in the London *Times* that the government of Tunis is about to establish a reserve to give refuge to the, at present, rapidly disappearing fauna of that country. It will include about 4,000 acres of wild mountainous country and an adjoining marsh of 5,000 acres.

Ammonia Bombs are being used on some of the national forests in this country to extinguish forest fires, especially in connection with brush fires, where the fire-fighters cannot get near enough to the burning area to beat out the flames. It is said that each well-exploded bomb will extinguish fire in a circle of about five yards diameter.

Sir Aurel Stein, of the Archæological Survey of India, is about to undertake archæological and geographical investigations in central Asia and western China, in continuation of the remarkable work he did in those regions between 1906 and 1908. His journey to the border of Chinese Turkestan by way of the Pamirs will take him through the Darel and Tanjir territories, which have not heretofore been visited by a European.

The Calosoma Beetle, an imported natural enemy of the gypsy moth, is found to be multiplying very fast in the moth-infested territory of Massachusetts and seems likely to do much toward keeping this pest in check. This is only one of a dozen or more species of insects that are being used in the moth campaign, so that, as *American Forestry* points out, the outlook is decidedly encouraging.

The King of England as a Meteorologist.—The London *Times* reports that King George has requested the Meteorological Office to supply him regularly with its daily weather map. Sir Frederick Ponsonby, in transmitting this request, explained that "his Majesty has always taken a great interest in the chart and details concerning the barometer since he was on board H. M. S. 'Thrush.'" The King is patron of the Royal Meteorological Society.

A Census of Greenland taken October 1st, 1911, shows a population of 13,459, as compared with 11,893 in 1901. The increase in the intervening ten years was the largest on record. There is practically no immigration, and the European population numbers only 384, of whom 70 were born in Greenland, 286 in Denmark, 4 in the Faroe Islands, and 24 in other lands. The largest settlement is Sydproven, with a population of 766; the smallest, Skansen in North Greenland, with a population of 46.

A Botanical Exploration of Amboina, in the Dutch East Indies, has been undertaken by the Philippine Bureau of Science with the interesting object of collecting, in their original localities, as many as possible of the plants described by G. E. Rumpf (Latin, *Rumphius*) in his monumental "Herbarium Amboinense," published in Amsterdam in 1741–1755. This work is of fundamental importance in the systematic botany of the Indo-Malayan region, on account of the large number of species founded on Rumpf's descriptions, but the identity of these is still uncertain in a great many cases. Dr. C. B. Robinson, of the botanical staff of the Bureau, is in charge of the explorations.

Karakul Sheep in Canada.—Consul Wesley Frost, stationed at Charlottetown, Prince Edward Island, reports that a small flock of karakul sheep is to be imported into that province from Texas. Prince Edward Island has recently achieved considerable notoriety through its remarkably lucrative fox-breeding industry, and leading raisers of foxes are backing the new enterprise. It is proposed to cross the karakul sheep with the long-wool sheep of the island, which are celebrated for the fine luster and strong fiber of their wool, in the expectation that a strain of hybrids will result having the tight curls of the karakul at birth together with the gloss and strength of the local breeds.

The Evolution of the Elevator has not progressed so far in Europe as in this country, partly, perhaps, because the symmetry of European cities is not yet ruined with the skyscraper, so that the elevator is hardly anywhere an absolute necessity. An American consular report points out the fact that in the Old World these contrivances are still regarded chiefly as means of carrying passengers up, not down, an idea expressed in the names "elevator," "lift," and "ascenseur," used, respectively, in America, Great Britain, and France. The commonest type of elevator met with in medium-priced hotels in France and Germany is controlled by a series of push-buttons on the outside at the bottom of the shaft. A person wishing to go to the third floor enters the car, and an attendant who remains at the bottom pushes button number three, the car stops at that floor, and the passenger, on leaving the car, calls down the shaft that the car is free. There is no corresponding provision for coming down—stairs are for that purpose.

The Manufacture of Hydrogen Gas for Spherical Balloons

Portable Plants for Military Use

By the Paris Correspondent of the Scientific American

THE progress recently made in developing the spherical balloon and especially the airship for military or other uses, has caused increased attention to be paid to methods for producing hydrogen gas in large quantities to meet the growing needs and in a sufficiently pure state. Of late the extensive use of airships in some countries as a part of the army outfit, has led to a search for suitable hydrogen-producing plants especially adapted for military use. Fixed hydrogen plants are of course useful in connection with aeronautic establishments and army centers, but what is especially valuable now is a portable outfit of this kind which can follow the army's movements throughout the country so that the airships can be supplied in the best manner. By the adoption of a hydrogen plant mounted upon railroad cars such as we represent here, it will be seen that the effective work of an airship will be at once increased, owing to the fact that it is constantly kept in good order by the available supply of gas. Wanting this, the airship would often be laid up, or at least subject to more or less delay in carrying out its work.

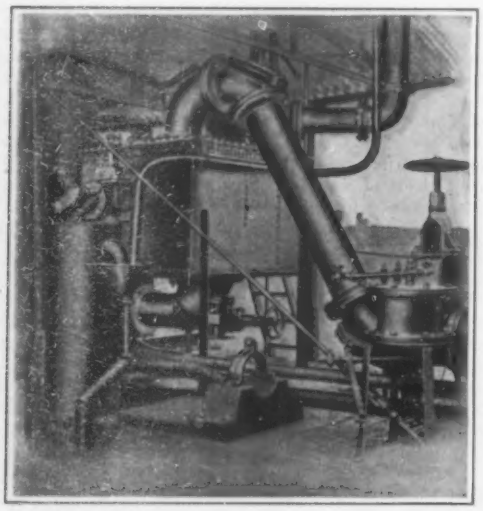
A hydrogen plant of the present kind not only serves for aeronautic purposes, but the gas can be supplied from either fixed or movable plants for use in different industries developed within the last few years, such as electric welding of plates or bars, and similar work for which a considerable amount of hydrogen is needed at present, also for cutting of plate iron by the hydrogen blowpipe. The hydrogen-producing methods used mainly up to now are purely chemical, electrolytic, or regeneration processes, but all have their disadvantages as compared with the present oil gas method which is used by the inventors. In some cases the first cost or operative expenses are high, and in others the gas needs to be produced on the spot where hydraulic or other cheap electric power can be employed or in the other cases where a water gas plant can be installed to advantage. In such cases the hydrogen needs to be transported in steel bottles under pressure, which is an added cost. Some processes do not give a pure enough hydrogen, one which shall be free from arsenic and chlorine, and it is known that arsenic has caused even mortal accidents in this way. As to chlorine, the gas for use in airships must be free from it, for chlorine attacks the balloon envelop.

According to the new German hydrogen process devised by Rincker and Wolter, the gas can be produced in any suitable place and the plant occupies but a small space, with a very cheap production. At the same time the compact shape of the apparatus makes it very well adapted for mounting upon cars so as to give a portable plant for airships. In fact, it appears that the German army is much interested in the present method and expects to use it for supplying airships of its numerous fleet. The gas which is produced in this apparatus has but a small percentage of nitrogen and has a specific gravity of 0.087 to 0.092. The operation is based upon the use of crude oil to produce the gas, so that a supply is easy to have. Instead of this, the producer can also be made to work upon benzine, refined oil, benzol and the like. Heating is done by the use of coke, as a general rule, although this can be replaced by charcoal. In the large engraving will be seen the general makeup of the plant mounted upon two railroad cars such as is designed for use in the field in army operations. In this apparatus the first part consists of the gas producer layout which is mounted in complete shape upon the front car, while the second car has the remainder of the plant, including the cooler, scrubber, and other purifying devices. This second part of the apparatus is especially needed for giving pure gas which airships require, as otherwise it need not be as elaborate for use in other industrial processes where less pure gas is needed.

The main apparatus on the front car consists of a pair of gas producers. Each of these has a heavy plate iron casing which is lined with firebrick. To remove slag and ash, there are two doors in the front which are kept closed while the gas is being produced. On the top of the apparatus is a hopper for use in feeding in the coke. At the bottom of the producer are good-sized pipes which bring in the air blast from the blowing chamber. The first of the two producers also has an oil spray device for introducing the oil at the top part. The producer is filled up with coke as is usual in such cases, and hot air is sent in at the bottom coming from a steam turbine driven blast fan, this being worked by the steam from the locomotive. If need be, the blast fan can also be driven by a gasoline motor or crude oil engine of the usual kind in the case of the portable plant, or with a stationary plant a gas engine, electric motor or any suitable mechanical drive can be used.

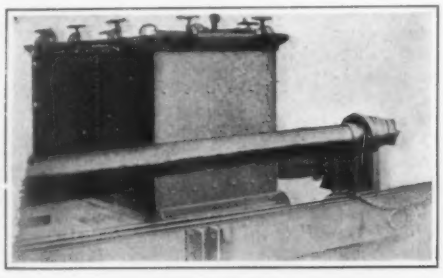
Oil for the spray is supplied by a suitable oil pump which feeds from a large tank on the car. It is necessary to heat this oil before feeding it into the producer, and the steam from the turbine is brought to the tank for this purpose, so that the heating is economically done. At the start of the apparatus, both producers are filled with coke and fired up. By the use of the hot air blast the coke is brought to a white heat, and

(Concluded on page 463.)

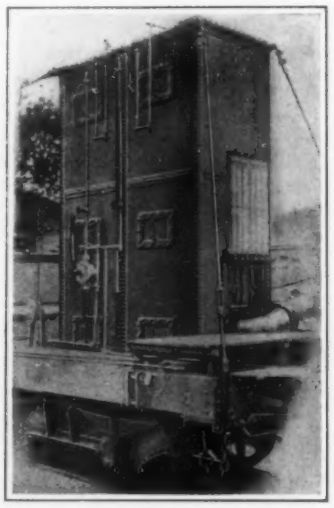


Water seal.

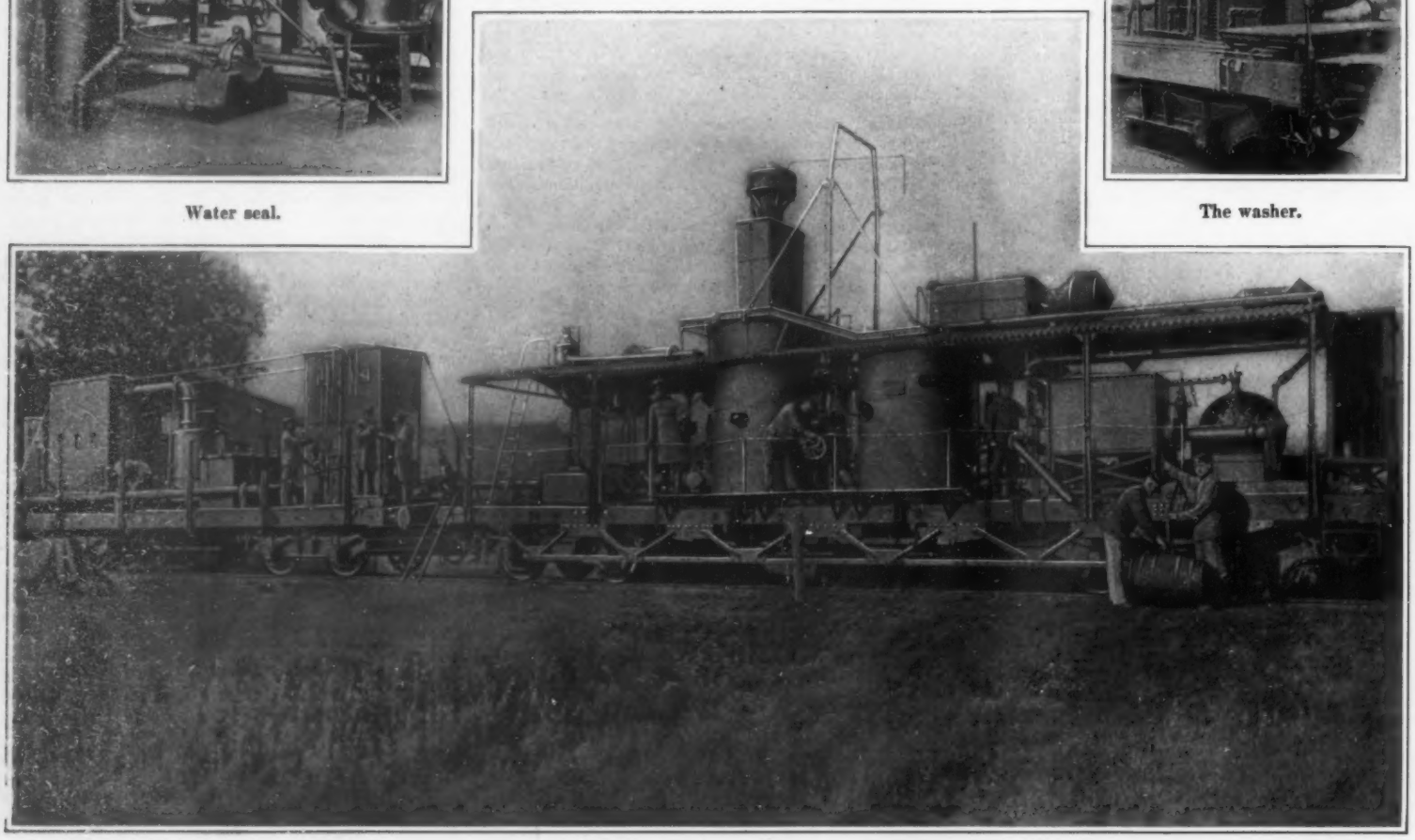
Acid cleaner.



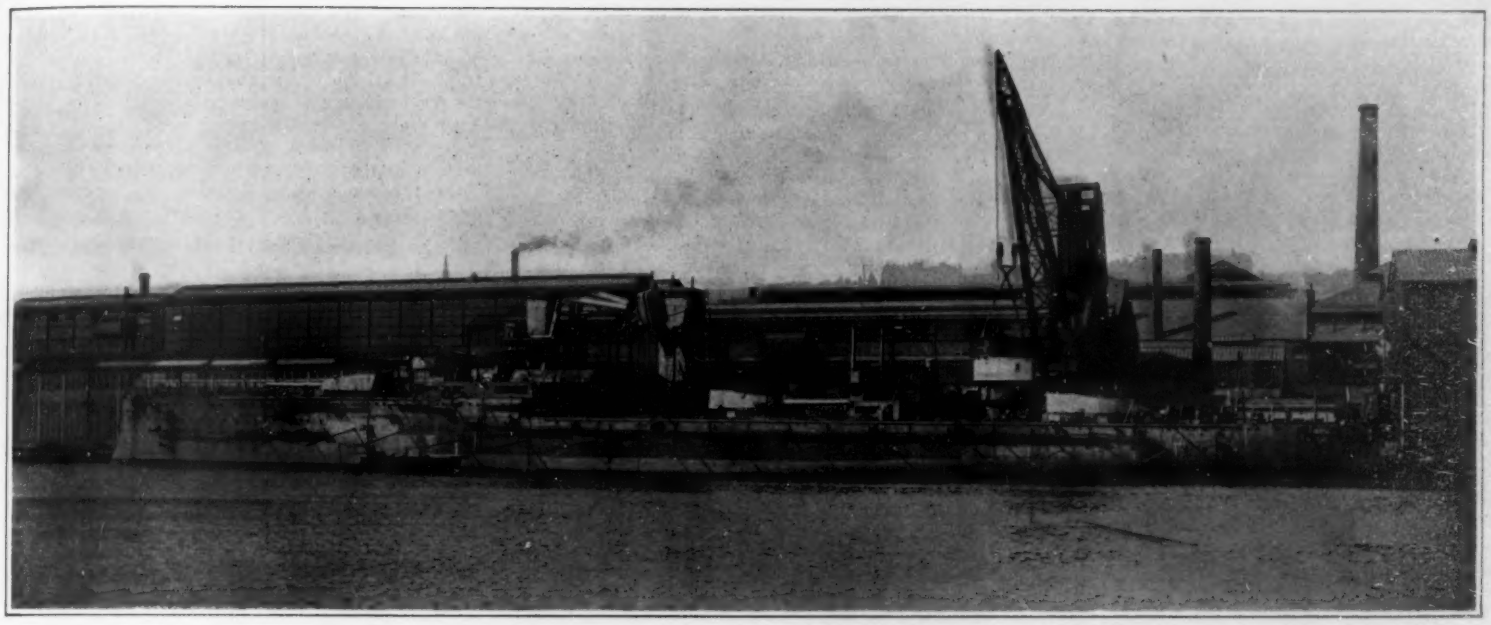
Dry cleaner.



The washer.



Portable hydrogen plant of the Experiment Corps of the German Army Engineers in the field.



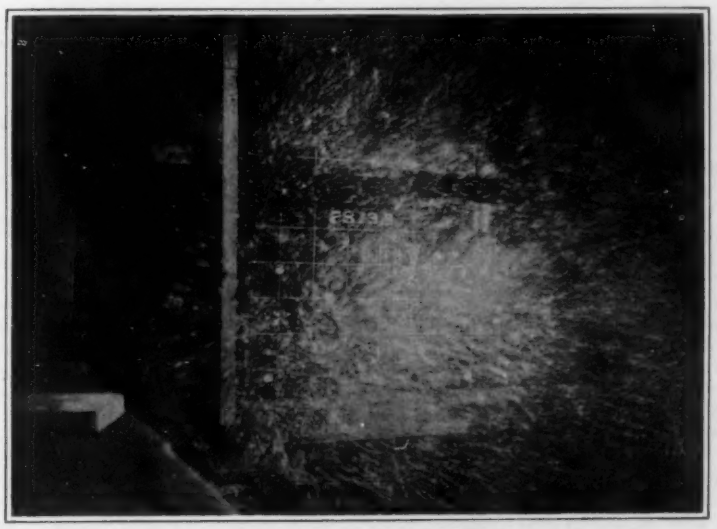
A 200-ton crane lifting a complete turntable on board the British dreadnought "Monarch."
FINISHING A BATTLESHIP AT THE ELSWICK WORKS

Some Notes on the Armstrong Works

A Pioneer in the Development of Modern Ships, Guns, and Armor

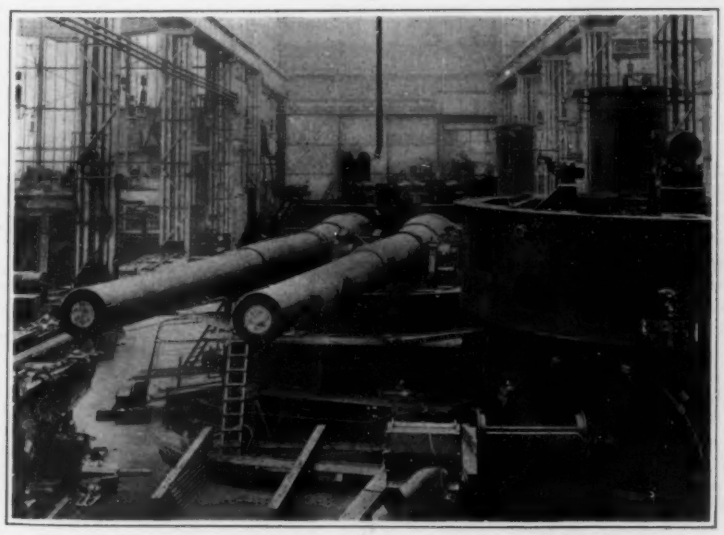
IN speaking of the great engineering firms of the present day, there are certain names that may be termed generic. Such, for instance, are those of Edison and Westinghouse in this country, Krupp in Germany, and Vickers and Armstrong in England. It is beyond the compass of this journal to give any extended description of a works which is so intimately associated with the last-named engineer; it is our purpose merely to give a few historical notes on the foundation and growth of the Armstrong concern, and a brief description of some of its output, as pictured in the accompanying illustrations.

To many who read these lines it will come as a surprise to learn that Lord Armstrong, the founder of the great works under consideration, started in life as a lawyer. But if he was a lawyer by profession he was an inventor by instinct and natural endowment, and as early as the year 1836, his thoughts turned to the promising possibilities of water as a motive power, and for several years he devoted his very keen mind to the study of hydraulics. As the outcome of this, in 1845, we find him lecturing to the Literary and Philosophical Society of Newcastle-on-Tyne, on the "Employment of a Column of Water as Motive Power for Propelling Machinery;" and a year later he exhibited his hydro-electric machine. Half a century later, lecturing before the same society, he spoke to his audience of the dense crowds that had collected in 1844 to see his hydro-electric apparatus, a crowd so dense that he had to enter the lecture room through a window. In 1846 the Royal Society elected him a fellow, and about the same time the first hydraulic crane was erected upon the Newcastle quay. So successful was this, that in 1847 an engineering establishment was opened upon the Tyne at Elswick. The success of the hydraulic crane was immediate and widespread; and upon the heels of this followed Armstrong's invention of hydraulic mining machinery. The invention of the accumulator, which rendered it possible to employ hydraulic power where there was no natural head of water, gave a great stimulus to the new invention.

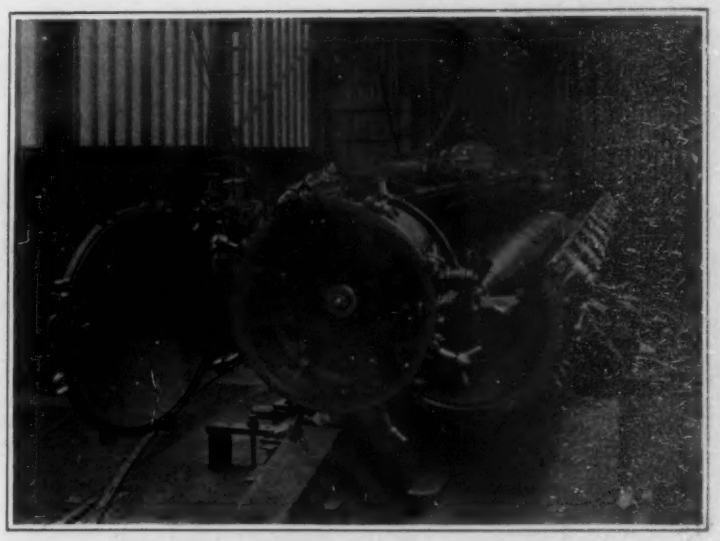


Instantaneous photograph showing the incandescent fragments of a shell which has broken up against a plate.

The outbreak of the Crimean war brought Elswick for the first time in touch with the British War Office. The heavy artillery of the British Service had made practically no advance since the time of the Peninsular campaign and the battle of Waterloo, forty years before. Armstrong, with that distinguishing faculty of transferring his whole energy and attention to various subjects in turn, now became completely absorbed in the study of guns, carriages and projectiles. In 1854, soon after the battle of Inkerman, he designed and built a three-pounder built-up gun which is still on exhibition as a historical relic at Elswick. It consisted of a core of steel enveloped in coiled iron cylinders shrunk one above another. The gun was rifled and breech-loading and carried a movable ventpiece. In bringing this gun into general use there was the usual government apathy and inertia to over-



Pair of heavy guns on their turret turntable—hydraulic mounting.



To save room, this torpedo tube receives its torpedo from the side instead of through the breech.

come, but ultimately a committee reported in favor of the Armstrong system on every point; indeed, there was no rival system in existence. Armstrong laid before the committee an entirely new system of field artillery, embodying in the gun a standard of accuracy and range hitherto unknown, and providing a piece that was complete with carriages, projectiles and fuses.

The distinguished inventor now entered the government service with the title "Engineer of the War Department;" and he at once made a gift of his gun patents to the nation. Just at this period the Elswick Ordnance Company was formed, and shortly thereafter Armstrong was knighted by the government in recognition of his abilities and services.

In 1863 the British government repudiated their arrangement with the Armstrong Company and it was not until fifteen years later that the Elswick experts succeeded in forcing upon the government their new type of gun, a type which with certain modifications is now adopted all over the world.

In 1869 the Ordnance Department of Elswick was started, and shortly thereafter there joined the staff of the company a certain Capt. Noble, a young artillery officer whose name was ultimately destined to become famous as the leading expert on explosives in the world. Sir Alfred Noble is to-day head of the huge ordnance department at Elswick, and chairman of the company. Bereft of government orders, the company began to establish a foreign trade which has since grown to enormous proportions. Up to date, the Armstrongs have built for the Japanese Navy 13 ships, for the Chinese, 22; for the Brazilian, 11; for the Chilean, 2; and for the British Navy, 44 ships. The total output of the firm to date numbers 135 warships, with a total displacement of 565,029 tons and a total horse-power of 1,137,897.

As a result of Capt. Noble's researches and experimental work, there came about a revolution of the whole science of gunnery; for by the introduction of slow-burning powder, he opened the way for the construction of an entirely new type of gun. This was completed and brought to the notice of the British government in April, 1877. Subsequently, that notable gunmaker, Whitworth, amalgamated with the Armstrong Company and a new company was formed under the title of Sir W. G. Armstrong, Whitworth & Company. In 1885 Armstrong opened up a branch for Italian work at Pozzuolli on the Bay of Naples, where for twenty-six years guns and mountings have been built for the Italian army and navy. Limitations of space prevent any further narrative of the development of the various branches of this firm, and it must suffice to say that in Newcastle alone, 120,000 men, women and children are dependent on the Elswick works for their subsistence.

One of the largest departments of this firm is that devoted to ordnance. We present illustrations showing the method of mounting the large-caliber, wire-wound naval guns, which are manufactured in such large numbers for the British and foreign navies. In our own navy we use a purely electric method of control, both for training and elevating. The British have always used and still adhere to the hydraulic method, which they claim gives excellent results in speed and accuracy. A striking illustration is the one showing a photograph taken at the instant of impact of a 9.2-inch shell against a Krupp plate. The work done upon the plate and the projectile resulting in the generation of intense heat is very graphically shown in this picture. The particles of steel dust and fragments, highly incandescent, have been caught by the camera as they were scattered, white-hot, in all directions. The torpedo tube illustrated is one of the latest pattern designed for underwater use aboard ship. In order to reduce the size of the torpedo room, the tube is formed in two halves, one of which can be unlocked and opened laterally as shown, to allow the torpedo to be inserted from the side. The tube is then closed up and locked by the manipulation of levers shown to one side of the launching tube.

Warships built at the Elswick works have to pass below a high level bridge, farther down the Tyne, on their way to the sea. Hence the peculiar appearance of the tripod mast of the ship, shown in our engraving. It will be seen that the mast is broken at the level of the smokestack, the top half of it being carried temporarily upon scaffolding, and subsequently riveted in position.

The Use of Cocoa Shells as Fodder for Cattle

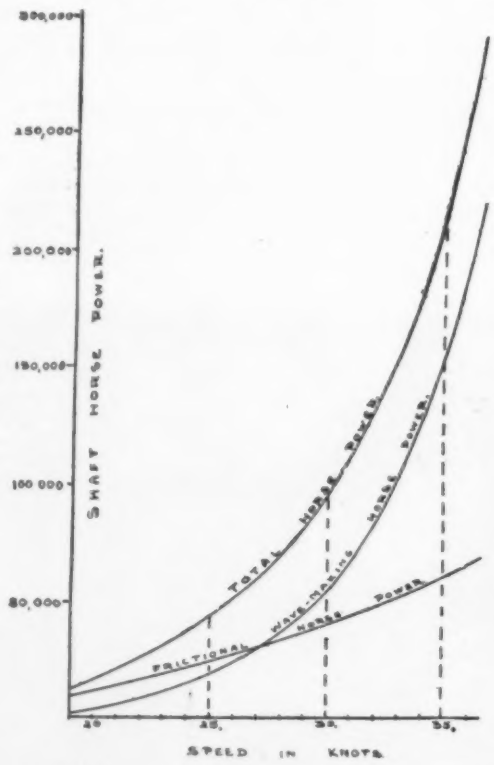
A USE has been found for the cocoa shells which are a by-product of the chocolate industry in France as fodder for cattle. The cows like it and it is nourishing and fattening, having much the character as wheat bran, but it is thought by some authorities to lessen the milk yield, though not lowering (but even increasing) its fatty content. A report on the subject has been made by an agronomic engineer named Lucas to the National Society of Agriculture of France. The question is to be further studied and is of importance, as this product consists of no less than three to five million kilogrammes yearly, according to *Les Annales*.

The Problem of High Speed in Ships

NOT many people understand why, in the higher ranges of speed, it is so difficult to add another knot or two to the speed of a fast ship. To the naval architects of course, the problem is a simple one. Not so to the layman, who, generally speaking, cannot understand why such a great increase must be made in the horse-power to gain the last knot or two. One of the most lucid explanations, of a popular character, of this problem is contained in the last issue of the *Shipping World*, in the form of an article contributed by a member of the Institute of Naval Architects of Great Britain. We republish the diagram accompanying that article, and the following is a digest of the paper.

The writer (M. I. N. A.) of this article was prompted to take up his pen by observing the ridiculous press statements as to the speed of the "Queen Mary," the latest of the British battle-cruisers, when she was on her trial. She was designed for 28 knots, and it was alleged in the press that she attained a speed of 35.7 knots and was expected to do better when the crew became more familiar with the ship.

In order to indicate what expenditure of power is involved in increasing the speed of a vessel, the accompanying diagram was prepared, showing the horse-power necessary to drive a ship of the dimensions of



The shaft horse-power of a battle-cruiser at varying speeds.

the "Queen Mary," 660 feet long, with a displacement of 27,000 tons, at speeds intermediate varying between 19 and 36 knots. At the designed speed of 28 knots the total shaft horse-power to be developed is 70,000. In order to reach the speed she has been credited with, 35.7 knots, the shaft horse-power necessary would be about 244,000, that is, about 3½ times the power that she was designed to develop under ordinary circumstances. That the machinery could never develop anything like this, needs no demonstration. The diagram shows that at 28 knots the horse-power is 70,000; at 29 knots, 81,000—an increase of 15.7 per cent. At 35 knots the horse-power is 213,000, at 36 knots 258,000, or an increase for this advance of 21.1 per cent. We can thus see that, at the lowest speed, 11,000 horse-power is required to increase the speed by one knot, and at the highest speed 45,000 horse-power is required to get the same increase. Furthermore, the writer tells us that this is by no means an extraordinary case; for in the case of some ships it would take double the power to increase the speed by one knot. It is possible that the "Queen Mary," with a designed horse-power of 70,000, has reached 29 knots and a trifle beyond, but that in itself is an exceedingly good performance.

The resistance to motion of a ship through the water consists practically of two parts—the frictional resistance due to the rubbing of the water against the underwater part of the ship, and the resistance caused by wave-formation. At the higher speeds, large waves are formed—that is to say, heavy masses of water are continuously being lifted above their normal level; and this, as anyone can understand, requires a correspondingly large expenditure of energy. At low speed, the frictional horse-power is greater; at about 27¼ knots the frictional and wave-making horse-power are equal. After that the frictional horse-power increases a little faster than the speed, and the horse-power necessary to roll up the ever-increasing waves formed by the ship's progress rises at an enormously accelerating rate.

Is the Panama Canal Liable to Damage by Earthquakes?

By Charles Davison, Sc.D., F.G.S.

THE recent occurrence of three rather severe earthquakes and of many others of less intensity in Panama has naturally drawn attention to the possible effects of still stronger shocks upon the canal. It is generally held, I believe, that the danger is so small that it may be disregarded. It is pointed out that the region is one in which earthquakes have in the past been rare and almost innocuous. And, to this, it is added that, owing to its geological structure, slight tremors, if anything, rather than destructive shocks, may be expected to occur in the Isthmian district.

For both reasons, there is much to be said, but neither seems to me quite conclusive. It does not follow that a country in which strong earthquakes have been infrequent or altogether absent for several centuries will remain immune for yet another century, though it is very probable that the present condition of stagnancy will endure indefinitely. But instances to the contrary are not unknown. The strong earthquake of 1884, which caused so much damage at Colchester (England) and the neighboring villages, occurred in a district in which no recorded earthquake has ever originated and in which none but slight shocks have been felt. The State of South Carolina was by no means celebrated for strong earthquakes when Charleston was partially destroyed in 1886. Nor was Alaska known as a distinctively seismic district until 1899, or perhaps until 1905, when the evidences of the greatest recorded earthquake uplift were revealed to Messrs. Tarr and Martin.

Again, too much stress should not be laid on the rarity or absence of actively-moving faults in the Isthmian zone, for surveys in mining districts show that faults may exist at the depth of the mines which a survey confined to the surface would not have detected. Nor is this all, for, as in the Swansea earthquake of 1906, the seismic evidence may indicate the existence of still more deeply-seated faults, which the most detailed observations either on the surface or in mines would never have revealed.

But, though it is not impossible that destructive shocks may occur in the immediate neighborhood of the canal, it seems on the whole probable that the prospect of any damage resulting to the works is but a small one. It should be remembered that the epicenter of the recent earthquakes was at a great distance from the Isthmian zone. It is true that, on October 1st, a few walls were cracked in Panama City, but the chief damage occurred in the province of Los Santos, and especially at Tonosi. As most of the after-shocks were felt in the same district, it is probable that the epicenter of the earthquakes was not far distant. If we take it to have been about a hundred miles from the canal, it follows that, to cause serious injury to the workings, the meizoseismal zone would have to attain the considerable area of about 30,000 square miles. Unless, therefore, there should be a marked advance of the epicentral zone toward the canal, it would seem that little danger is to be apprehended from earthquakes originating in the Los Santos center.

But, even if a violent earthquake were to occur at some place much nearer the canal, it does not follow that the works would be seriously injured. Twenty-five years ago some interesting observations were made by Messrs. Sekiya and Omori at Tokyo. Two similar seismographs, which had previously been compared on a shaking table, were placed, one at the bottom of a pit 18 feet deep, the other on the surface close to the pit. The records given of the earthquakes of two years (1887-1889) were afterward compared. If the earthquakes were slight, it was found that the records on the surface and in the pit were nearly the same. But, if the earthquakes were strong, the difference was at once noticeable, not so much in the large undulations as in the small tremors or ripples superposed on them. In the pit, the ripples were to a great extent smoothed away. If the intensity of an earthquake shock depended only on the range of the motion, this would not be of much consequence. But it depends also on the brevity of the period of the vibrations, and, on this account, the ripples possess an intensity several times greater than the large undulations. The effect of smoothing away the ripples is thus to reduce the actual intensity of strong earthquakes, so that at the bottom of the pit may be only about one fifth of that at the surface.[1]

[1] *Japan Seis. Soc. Trans.*, vol. 16, 1892, pp. 19-45.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Increase the Patent Office Force

To the Editor of the SCIENTIFIC AMERICAN:

I am heartily in sympathy with the sentiment and suggestions expressed in the article, under Correspondence, entitled "A Plea for an Increased Patent Office Force," appearing under date of October 25th of your valuable paper.

I think we need more discussion along this line in order to awaken public interest in this matter.

Dinuba, Cal. HOWARD N. WEDDLE.

Air Compressors in Whale Catching

To the Editor of the SCIENTIFIC AMERICAN:

Reading an article on novel uses of compressed air which appeared in the SCIENTIFIC AMERICAN of July 5th, 1913, recalls to the writer a rather novel use of compressed air which I do not think is known to your readers.

Some of the steam whalers that carry on the whale fishery off Tierra del Fuego are equipped with Westinghouse steam-driven compressors like those used on the locomotives to operate the air brakes, and when a whale is killed and the tow line attached, a hollow lance tube with a hose attached is thrust through the blubber and the air compressor started. This inflates the carcass of the whale and facilitates towing it to the station where the try works are situated.

Buenos Aires. J. P. STONE.

The Double Report of Gun Fire

To the Editor of the SCIENTIFIC AMERICAN:

In an article you published some time ago on a visit to the Atlantic fleet during target practice, the writer speaks of hearing a double report when a shell from one of the small guns passed near their ship. He states that one of these reports came from the gun, but that the officers of the fleet were not sure as to the cause of the other.

I mentioned this recently to a friend who has seen active service in the Philippines, and he said that he had often noticed a sharp report when a steel-jacketed bullet passed overhead, and that when the bullet passed within a yard or so the report was almost as loud as that of the rifle. This noise is not noticeable in the low-velocity lead bullet.

I mention this in case there are any of your readers who are interested in this subject.

Baltimore, Md. AUGUST MENCKEN.

Automatic Sprinklers at Sea

To the Editor of the SCIENTIFIC AMERICAN:

In your editorial on "The Peril of Fire at Sea," in issue of October 25th, 1913, the question is asked, "Why is it that the automatic sprinkler, which has proved so highly efficient ashore, has not been applied to the protection of ships?"

I beg to inform you that automatic sprinklers have been installed in a number of steam vessels plying the Great Lakes and Long Island Sound. I have before me photographs of two lake steamers that are partially protected by sprinklers. As you say, "structurally considered, the problem should not be a difficult one." And the problem of water supply is easily solved by the provision of automatic Underwriter fire pumps, or air-pressure tanks, maintaining constant pressure of water on the sprinkler system at all times; and where there is danger of freezing, the installation of a dry-pipe system will obviate that difficulty, as is the practice ashore.

Now, Mr. Editor, the answer to your question is, that sprinklers are not installed generally in ships for the same reason that they are not installed in all factories. The owners will not pay for them; it is so much easier to "take a chance." P. D. C. STEWARD.

Philadelphia, Pa.

The Busiest Railroad Terminal

To the Editor of the SCIENTIFIC AMERICAN:

A paragraph in Engineering Notes in the October 18th number, gives the impression that the busiest railroad terminal in America is the South Station at Boston, with 38,411,507 passengers in and out.

It will probably surprise most of your readers to learn that the "Busiest Terminal in America" is not in Boston, nor in New York, nor yet in Chicago, but is in fact on the other side of the continent entirely.

The business of the Union Ferry Depot at San Francisco surpasses even that of the South Station at Boston by over a million and a half a year.

San Francisco is so situated that nearly all passengers reaching the city are compelled to do so over the ferry lines of the various railroads, all landing at the Union Ferry Depot.

For the fiscal year ending June 30th, 1913, the official figures give a total number of passengers handled as 39,955,573 distributed as follows:

Southern Pacific Company	19,340,227
San Francisco-Oakland Terminal Railways	14,407,503
Western Pacific Railway	89,362
Santa Fé	299,987
Northwestern Pacific	5,334,506
Monticello Steamship Company	483,988
Total	39,955,573

Oakland, Cal. EDW. G. MERWIN.

Spreading and Overturning of Rails

To the Editor of the SCIENTIFIC AMERICAN:

I write this for information concerning "spreading rails." Do rails spread and cause wrecks on railroads or do they turn over?

I think there is a difference between rails spreading and rails turning over.

If rails spread the rails would be pushed *out* at base of rails and spikes would be pushed *out* from rail on outside or else their heads would be sheared off.

If rails turned over then the spikes are pulled on the inside of rails.

In my opinion we would not hear of rail spreading if angle bars at rail joints did not get loose and allow pounding at joint, with the result that the wheels push the rail over at joint and turn the whole rail over.

This is the opinion of a man that was for thirty-five years a trackman on a first-class railroad, and had as much experience with wrecks as almost any man, and I think he was right.

Will some one better informed enlighten us on the subject? ZACH T. HOSKINS.

Chicago, Ill.

[Our correspondent is correct in his explanation of the action of the rail on the spikes in the respective cases of turning over and spreading. Low joints, in our opinion, are only one cause tending to produce spreading and overturning by setting up oscillations of the engine and cars.—EDITOR.]

The Use of Oil at Sea

To the Editor of the SCIENTIFIC AMERICAN:

Not enough attention has been paid to the use of oil in the rescue of the "Volturno's" passengers.

The great increase in the number of lifeboats since the "Titanic" disaster is shown not to have solved the problem. Even with the most improved davits, boats cannot be launched in a high sea. From a height like that of the decks of the "Olympic" or "Imperator," the boat and passengers will be lowered to certain destruction.

The use of oil has often been shown in such cases. Every tug with barges in tow should be compelled to take a supply. Seven lives were lost off Cape Cod last week, following hundreds of others. If oil were used freely, the tugs could take the men off the barges in any weather; whereas now they are compelled to let them drift to destruction.

Life savers along the coast could throw oil, in rockets or projectiles, to windward of a stranded vessel, and greatly increase the chances of saving the crew. The Patent Office records are full of such devices, and no doubt the simplest would be found the most effectual.

The Ordnance Department of the Army would be well employed in co-operating with the Life Saving Service in perfecting such a projectile. The Revenue Service could use oil freely in the many rescues they are called on to make. The device is an old one, but its use should be modernized and made effective, and no ship should be allowed to sail without proper equipment for the use of oil, for the safety of its own passengers, or saving the lives of others, found in danger.

New York city. JOSEPH D. HOLMES.

To Our Subscribers

WE are at the close of another year—the sixty-ninth of the SCIENTIFIC AMERICAN's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year.

To those who are not familiar with the SCIENTIFIC AMERICAN SUPPLEMENT a word may not be out of place. The SCIENTIFIC AMERICAN SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

The American-French Radio Time Signal Experiments.

THE Naval Observatory succeeds in receiving time signals from the Observatory of Paris by radio telegraphy *via* the Eiffel Tower and Arlington, for longitude determination.

For about a month the Naval Observatory at Washington and the Observatory of Paris have been sending time signals to each other, using the Arlington radio station and the Eiffel Tower in a campaign to determine the difference of longitude between the two places and the velocity of propagation of radio signals through space. Owing to interference from other radio stations, but principally to discharges of atmospheric electricity, there has not been much success until the night of November 19th, when the beats of the Paris clock as transmitted by radio signals were compared with the Washington clock for some minutes by the method of coincidences. The season of the year when atmospheric conditions are best for radio work is now coming on, and it is expected that the work in which the American and French commissions are engaged will proceed as planned.

The Naval Observatory was the first institution in the world to have its time signals regularly transmitted by radio telegraphy for the benefit of ships at sea, enabling them to check their chronometers and thereby better determine their longitude, and it also has sent signals in this way to enable surveying parties under the Hydrographic Office to determine the longitude of points which they used as bases.

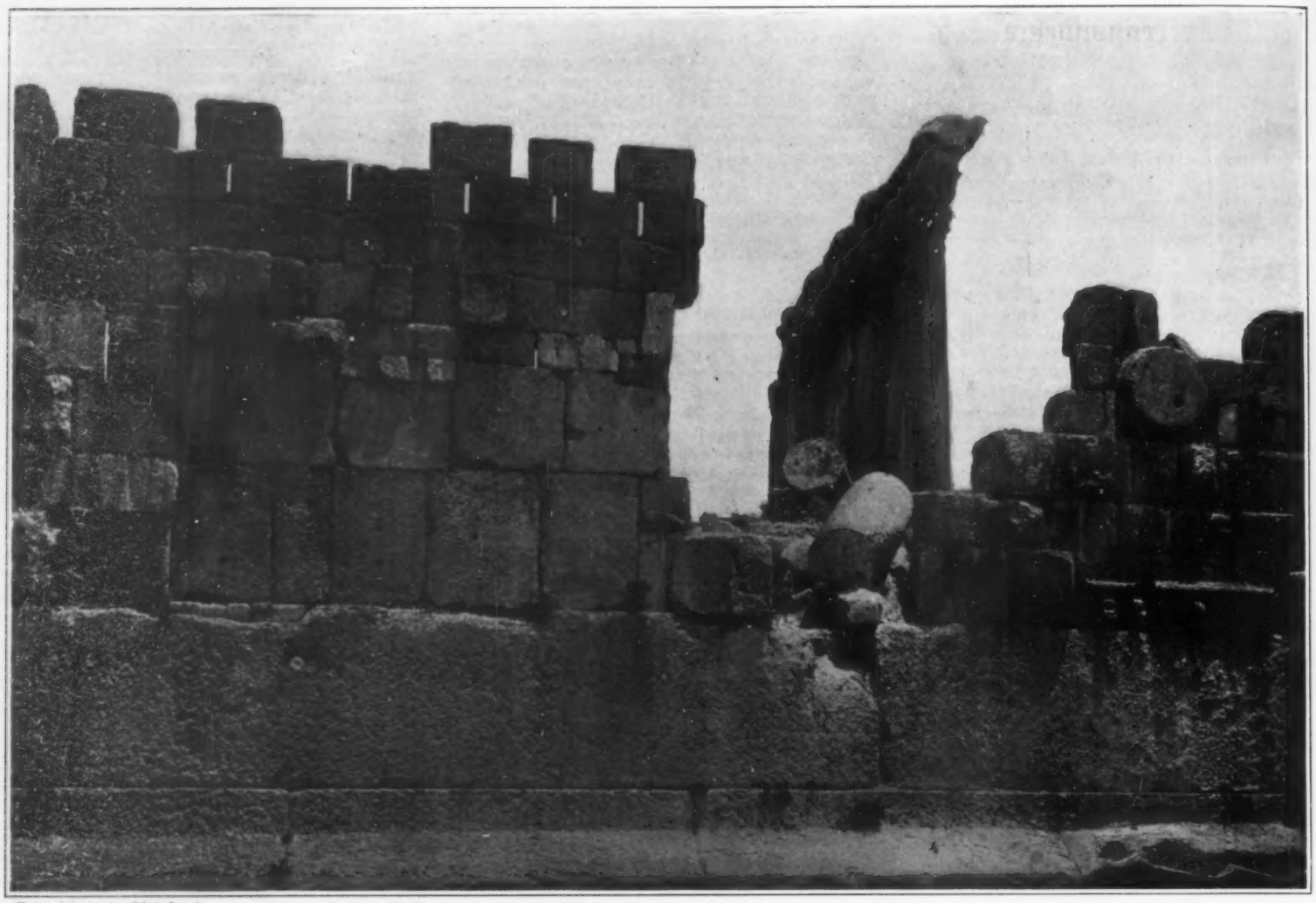
Although radio signals travel through space at approximately the velocity of light, there is a slight but appreciable loss of time (a small fraction of a second) in starting such a signal on its journey away from the aerial of the sending station and in receiving it at the other end. It was desirable to eliminate this loss or accurately measure it, and the observatory was considering this problem in 1912, when it was ascertained that the French had already solved it by one of the methods which were suggested for study, viz., that of "coincidences." Here was a beautiful solution and the superintendent of the Naval Observatory, realizing its possibilities, proposed that steps be taken to arrange with the French government to exchange signals between the Eiffel Tower and Arlington.

The Navy Department would have been content if granted simply the privilege of taking its own astronomical observations in Paris and using the Eiffel Tower radio station for sending signals; but the French government showed the keenest interest in the problem, and last spring sent five of its leading experts to this country to study it, while the Navy Department had representatives in Paris for the same purpose. As a result of these preliminary investigations it was agreed that there would be an American and a French commission which would work side by side, but independently, each commission having a party in Paris and another in Washington at the same time, until one half of the observations and exchanges of signals were completed, when these parties would exchange stations, taking their instruments with them, and repeat the process.

The interval since last April has been devoted to getting ready. Two special telescopes have been provided for the American parties, which are designed to eliminate as far as possible instrumental and personal errors, and the exchange of stations is intended to still further eliminate such errors from the final results. Two instrument houses have been built, side by side, at the observatory, identical in design, one to house the French and the other the American party. These houses are considered models of their kind and will be available for future use in similar work.

Four radio experts were ordered from the fleet to the Naval Observatory to get the necessary experience to enable them to compare the clocks, separated as they are by about 3,800 miles, and to assist in making preparations. Two officers who had had experience in hydrographic surveying were also detailed to join the astronomical staff of the longitude campaign. A great many details had to be studied and tested at the observatory in preparation for this great undertaking, as the apparatus in Washington and Paris differ considerably.

The same signals which are set by the Arlington radio station for the Naval Observatory are to be used by naval hydrographic surveying parties in the West Indies and Central America, and fifteen observatories scattered from Maine to California have already indicated their desire to take advantage of them to determine longitude. In this way the undertaking inaugurated by the Naval Observatory will have a far-reaching scientific and practical influence, and that observatory already is considering a still more far-reaching undertaking, namely, that of tying together the continents of North and South America and many of the islands of the Atlantic and Pacific, and possibly some of the countries in western Europe, by longitude determinations based on radio signals to be sent from the radio station to be built by the Navy on the Panama Canal Zone.



Photograph by American Colony, Jerusalem.

The cyclopean wall and lofty pillars of the Great Temple, Baalbek.

Baalbek the Mysterious

In Many Respects the Most Famous Ruins of Bible Lands

By Harold J. Shepstone

AMONG the grandest relics of a great nation's vanished glory stands the ruins of Baalbek, certainly one of the most mysterious of ancient cities. These ruins in Syria are rightly renowned for their massiveness and for the great amount of both bold and delicate carvings with which they are adorned. An account of them is appropriate, for through the German excavators, under Dr. Sabelsheim and Prof. Puchstein, who have been toiling here for four years now, much new and interesting light has been thrown upon the history of this once famous city. Indeed, these savants may be said to have done for Baalbek what Layard did for Nineveh and Babylon and Schleimann for ancient Troy. Still it must be admitted that the work of the Germans has not been altogether a disinterested one, for the Berlin museums now possess many of the finest examples of carvings found here.

These wonderful ruins, in some respects the most famous in Bible lands, lie in the narrow picturesque valley of the Litani a short distance west of the little town of Baalbek, at an altitude of some 4,000 feet above sea level. The town is about ten miles north of the railway which runs from Beirut to Damascus. To visit the ruins, therefore, one goes by train from Beirut to El-Mullakka, from which place they can be reached in an hour or two by carriage. Here the ancient Assyrians worshipped Baal, the Greeks, Helios, the God of the Sun, and the Romans Jupiter. The early Christians, too, worshipped the God of Jehovah at ancient Baalbek, turning the great pagan temple into a Christian shrine. They, in turn, were driven out by the Arabs who converted these wonderful old temples into fortresses.

Although inscriptions and tablets found make this very clear, we have, nevertheless, very little knowledge of ancient Baalbek. Its history is lost in the thick obscurity of a very remote past, and even its existence was for centuries utterly unknown. The extraordinary silence of the ancient Greek and Roman writers concerning a place so extensive, wealthy, important, and magnificent is unaccountable. John of Antioch is the only ancient author by whom it is mentioned. And he was wrong in many of his statements. He ascribed these ruins to Alius Antoninus Pius, declaring that he built the great temple at Heliopolis, near Libanus, in Phoenicia, which was one of the wonders of the world in the early days of the second century. Inscriptions found by the German excavators would go to show, however, that the great temples were begun by the Romans in the first century after Christ, and this view is also confirmed by the Syrian writer Michel Alouf, who is a native of Baalbek, and who has devoted an immense amount of time to the patient study of all documents bearing upon the history of his birthplace.

Oriental writers speak of Baalbek at the period of the first Arab invasion, describing it as being then one of the most splendid of Syrian cities, having stately palaces adorned with monuments of great antiquity, abounding with fountains and artistic adornments of wonderful richness, variety, and beauty. Its commercial importance is shown by the fact that during its siege by the Moslems, shortly after the fall of Damascus, its enemies captured a caravan bearing four hundred loads of silk, sugar, and other commodities; and its wealth is ascertained by the ransom that was executed, of two thousand ounces of gold, four thousand ounces of silver, two thousand silk vests and a thousand swords, in addition to the arms borne by its defenders.

Most visitors to Baalbek find the ruins confusing and somewhat bewildering. Indeed, seen at a distance they are a little disappointing, but once you stand among them and survey the massive columns, marble doors of prodigious dimensions, windows and niches bordered with exquisite sculpture and fragments of beautiful arches, cornices, capitals and entablatures, you are amazed and mystified at it all. Yet all these ruins only represent the remains of two grand temples and a smaller one—the Great Temple, or Temple of Jupiter, the Temple of Bacchus and a small circular Temple to Venus. Nevertheless, in the colossal walls of this ancient Syrian acropolis one could place many of the ruins of ancient Rome. The architecture of four, if not five ages, is represented—Phoenician, Greek, Roman, Christian, and Saracenic, while some authorities consider that there are distinct traces of Solomonic architecture.

The ruins stand on an artificial oblong plateau of masonry, probably of Phoenician origin, about 331 yards long by 200 broad, and varying in height from 15 to 30 feet. The enormous extent of this vast enceinte may be better realized when it is remembered that the main courtyard, which serves as the approach to the Great Temple, is nearly 150 yards long and some 120 yards wide, dimensions only surpassed by those of the Great Temple at Karnak, in Upper Egypt. Beneath this colossal platform are vaulted passages like tunnels, and it was from these passages until somewhat recently that the temple area was reached.

First and foremost among these ruins therefore comes the Great Temple. Its main entrance was from the east. Here a wide flight of steps led up to the propylæa, nineteen feet above the gardens and orchards that now surround the ruins. This portico was opened to the east the full width of the stairs and the worshippers used to enter between rows of columns on the bases of three of which are inscriptions stating that the temple was erected to the "Great Gods" of Heliopolis. When the Arabs conquered the city they converted these temples into fortresses, and to this end to a certain extent remodeled them. The columns mentioned were removed, the staircase taken away, and the material used to construct a solid wall where the columns had been. The German excavators have torn away the wall constructed over the bases of the columns and built a narrow staircase where the great one used to be, so that to-day one enters again as did the Roman worshipers of old. Indeed, every visitor to the ruins to-day owes the Germans a debt of gratitude, for in removing the Arabic work they have made the original plan more easily comprehensible. Tons of débris have been removed and weak parts in the ruins have been strengthened.

From the Propylæa one passes to the hexagonal fore-

court by means of a central doorway with a smaller one on each side. This small court was surrounded by a colonnade and on four of the six sides by exedræ or lateral chambers. The Arabs also blocked this threefold entrance and converted the exedræ into fortifications, filling them with thick masonry. Through the great block of stone which has until lately blocked the entrance here, the excavators have cut an opening.

Proceeding inward one passes through a triple entrance into the Great Court, or Court of the Altar. Some idea of its immense size may be gaged when it is stated that it measures 440 feet in length and is about 370 feet in width. The central portal as well as one of the small side portals has fallen in, and the pieces which formed the arches have been collected and laid together on the ground below the places where they had originally been. Around this court on three sides, omitting the west and where a staircase led up to the level of the Great Temple, are square and semicircular exedræ, which contain many handsome niches for statues, of which, unfortunately, not a single example remains. These were designed as resting places for the devotees who came here to worship. In front of these exedræ ran a colonnade of polished Egyptian granite surmounted by an entablature bearing carvings of rare beauty. The columns have all fallen and now with fragments of their entablature and capitals, lie about the court.

In the center of the court, rather nearer to the steps ascending to the temple beyond, stands what is left of the large altar. On each side of it is a pool or basin used for ablution in connection with the religious rites here observed. It was only during the recent excavations that the altar was discovered and also the steps by which the priests ascended at the time of sacrifice. When these temples were taken possession of by the early Christians a church was erected over this altar, part of which was destroyed and then the space leveled up with earth so that the church floor was above the top of the altar. The lower part of the staircase was also filled over while the upper part was removed to accommodate the apses. The Great Temple beyond was demolished to furnish materials for the construction of this church. The idea of these early Christians was to obliterate heathenism by placing this Christian shrine right in the center of this renowned temple of the heathen gods. As it seemed to work in best, the apses were placed as above described on the west with the entrance from the east. Later this was considered unorthodox and an apse or apses were built at the west end so that now traces of them appear at both extremities of the ruins.

From the spacious court of the altar one passes by means of a wide flight of steps into the Great Temple itself. All that is now left of it, however, are six columns which formed part of the peristyle still standing *in situ* capped with Corinthian capitals and joined by an ornate and massive entablature. They are perhaps the crowning feature of Baalbek, and piercing the sky-

Photograph by American Colony, Jerusalem.

Block of ceiling in peristyle of Temple of Bacchus, Baalbek.

line as they do are seen long before the ruins are reached. Prof. Taylor says of them: "I know of nothing so beautiful in all remains of ancient art as these six columns. . . . From every position, and with all lights of day or night, they are equally perfect." From a little distance their perfect proportions make them appear smaller than they actually are. A wall 40 feet high forms a fit pedestal for these magnificent columns. They are 7½ feet in diameter and with their bases and Corinthian capitals tower 70 feet into the air, the whole being crowned by a graceful entablature some 15 feet in height. Each shaft consists of three separate pieces of stone held together with iron. The Turks have barbarously made incisions in the columns at several places in order to remove the iron cramps.

How the ponderous stones which form the colossal cornice were raised in position and placed across the six gigantic but graceful columns is a problem which has puzzled engineers as much as savants and antiquarians. The most plausible solution suggested is that a sloping embankment of earth was built from the quarry a quarter of a mile distant to the top of the peristyle, and the stones drawn on rollers by thousands of slaves, the method resorted to by the ancient Egyptians when they built the great Pyramids. The numerous mounds of earth still to be seen in the great court piled against the wall give some color to this theory.

So much for Baalbek's first and most famous ruin. We now come to the second, the Temple of Bacchus, which lies to the south of the Great Temple, entirely independent of it and on a much lower level. It had no court, but was entered by a flight of steps from the east. The walls of the cella, which is oblong, are quite plain on the outside and are built of carefully dressed stone, the joints so perfect that a knife blade cannot enter between. Around this at a distance of ten feet, on the two sides and ends, runs a row of smooth columns which form the Peristyle. These, including their capitals, are about 52 feet high and are surmounted by a magnificent entablature and connected with the walls of the cella by enormous slabs of stone which are elaborately carved with the heads of emperors, deities, and interwoven with floral designs, forming a most unique ceiling. While the walls of the cella are still perfect, more than half of the columns forming the peristyle have fallen, the north side being the best preserved. Here in a niche may be seen a tablet commemorating the visit of the German Emperor to these ruins in 1898.

Notwithstanding the profuse ornamentation of the peristyle it is exceeded by that of the portal to this temple, which is indeed the gem of the entire edifice. The door posts are elegantly carved with figures of Bacchus, fawns, cupids, satyrs and bacchantes, woven around which are grape vines and clusters of fruit, also poppies and ears of wheat, all of which are symbolical of the reveling which the temple suggested. This great doorway stands 43 feet high and 21½ feet wide, while the carving of the posts just mentioned covers a space about six feet wide. On both sides of this door stand graceful fluted columns forming the prostyle or portico, while the plain ones of the peristyle, which stand behind them, seem to reflect their beauty. As already stated, these two temples stood

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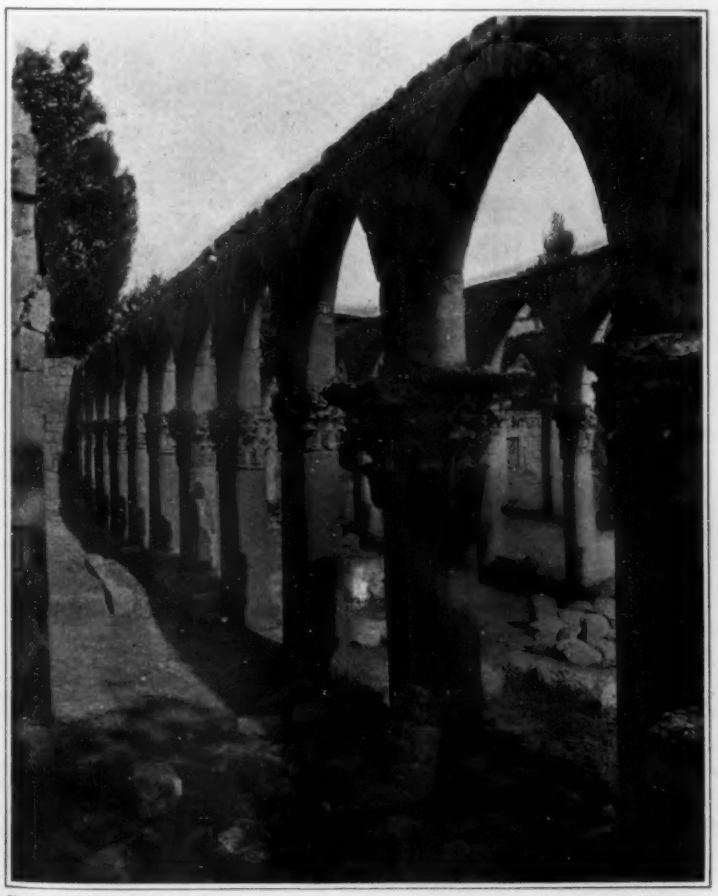


Photograph by American Colony, Jerusalem.

Ruins of the mosque, once a Christian church, Baalbek.

Photograph by American Colony, Jerusalem.

Lofty pillars of the Great Temple, Baalbek.

An Apparatus for Automatic Transmission and Reception of Wireless Messages

By Lucien Fournier

THE apparatus described below is based on the principle of the phonograph. It comprises, in the first place, a cylinder of wax on which a sapphire-pointed tool inscribes Morse telegraphic symbols, giving the proper length to each letter and to each space between letters or words. To the record thus produced is applied a needle, which follows the trace made by the graver. The reproducing needle is connected by a lever to a key which operates a wireless transmitter.

The dispatch thus automatically launched into space is received by means of a similar apparatus, connected with the relay of the receiving station. The currents of this relay, by traversing the coils of an electromagnet, operate the graver, which records the message upon a second wax cylinder.

In either case the cylinder is turned by a small electric motor placed in the base of the apparatus. The axis of the cylinder is connected by a belt to the motor and by gearing to a horizontal shaft, which moves a sliding bridge or carriage by means of a comb and a helicoidal screw. The bridge can be brought back to its initial position by pressing a lever.

The sliding bridge carries a platform upon which the graving, reproducing and obliterating tools are mounted. The graver is attached to a bent lever pivoted to the platform. The free end of this lever is connected by a silk cord to the armature of an electromagnet. When a current traverses the electromagnet the armature is attracted and, by the intermediation of the cord and lever, the sapphire point is forced into the wax cylinder. When the current ceases the graver and the armature are brought back to their original positions by a spring.

The reproducing needle acts in a different manner. In order to bring it into contact with the grooves of the cylinder, the platform must be adjusted by means of two elevating and lowering screws. When this adjustment has been correctly made, the point of the needle enters the groove and follows every indentation made by the graver. The needle is attached to the short arm of a lever, pivoted to the platform, and its movements are transmitted, in amplified form, to the curved end of the long arm of the lever, which, by pressing on a fixed metallic contact piece, automatically performs the functions of a Morse key, and makes and breaks the current of the wireless transmitting apparatus. Perfect contact is assured by a spring. The message recorded on the cylinder, therefore, is transmitted automatically and with perfect accuracy.

The sliding bridge also carries a third tool, called an obliterator, which is brought into contact with the wax cylinder in order to efface the record of the preceding message.

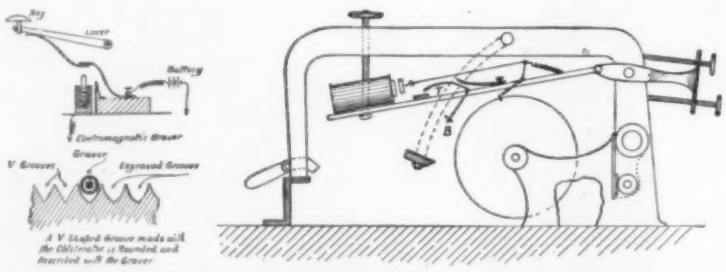
We have said that the cylinder is turned by an electric motor, but this is done only in the automatic transmission and reception of messages. In making the original record of the message to be transmitted the cylinder and the graver are operated manually by means of a special mechanism, placed in the base of the apparatus. This mechanism has three levers or keys. The middle key acts on the cylinder only and has no electrical connections. By pressing it once or twice, the cylinder is turned, by means of a wheel and ratchet, through the space between consecutive letters or words. Each of the other keys is similarly connected with the cylinder by a wheel and ratchet, and also carries a flat spring, the end of which supports the end of a similar spring connected with a galvanic battery. When the key is depressed the spring attached to it, which is still in contact with the battery spring, strikes the top of a vertical metal rod which is surrounded and supported by a spiral spring, and is connected with the electromagnet of the graving tool. Thus the electromagnet is energized and the sapphire point is pressed into the wax. At the same time the cylinder is turned through a shorter or longer arc, according to the key used, so that a dot or a dash is recorded. The travel of the key lever is rather long, but the duration of the current is limited by a stop which arrests the descent of the battery spring and breaks its contact with the spring attached to the lever, while the key is still descending and turning the cylinder by means of the wheel and ratchet. This short currentless interval affords the graving tool time to remove itself and its shavings from the groove. The action of the dash key is identical with that of the dot key, except that the former produces a longer current and turns the cylinder through a greater arc.

In order to transmit the message thus inscribed it is only necessary to place the reproducing needle at the beginning of the groove and to connect the cylinder with its electric motor. Before the graving tool is used it is advisable to cut a V-shaped groove with the obliterator. The graving tool, placed in this groove, to which it gives the form of a U, makes a much better record than it would produce on the unprepared wax cylinder.

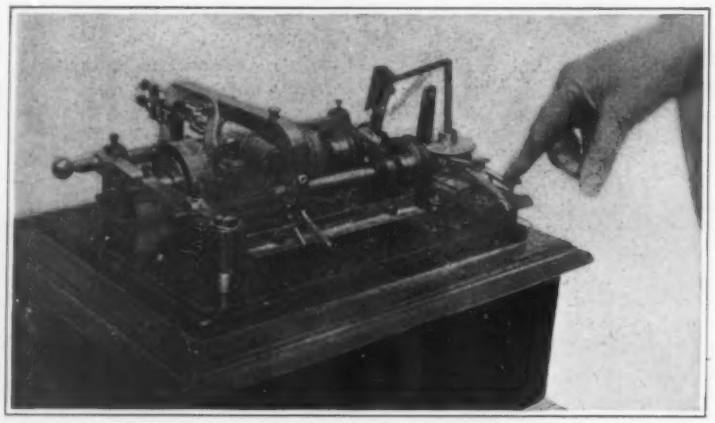
We have said that the apparatus is equally useful for the automatic registration of wireless messages which come to a receiving station from any transmitting station. For this purpose it is only necessary to intercalate the electromagnetic graver, by means of a suitable commutator, in the circuit of the relay of an ordinary receiving station. The currents produced by the relay, traversing the electromagnet, cause the graver to operate in conditions identical with those in which the original record was made, except that the cylinder is turned with uniform speed by its electric motor. As the signals are being received and registered, they may be heard by means of a "buzzer" inserted in the circuit of the electromagnetic graver. A wireless message can thus be heard as distinctly as an ordinary telegraphic message.

In this last application the motor that drives the cylinder is started by the first call of the sending station, but, in order to eliminate the action of stray waves, the circuit of the electric motor is broken by a clockwork if the call is not repeated within a certain length of time.

This apparatus, the invention of M. Leon Champeix, is capable of rendering important service in wireless telegraphy, by making possible a very accurate transmission and the repetition of a dispatch that has not been satisfactorily received. In receiving, the advantages of the apparatus are still greater, as the received and registered message can be read at leisure by turning the cylinder with any desired speed, thus obviating the necessity—now of frequent occurrence—of compelling the sending station to repeat the message several times.



Diagrammatic view of the apparatus, showing also the graver and sending key.

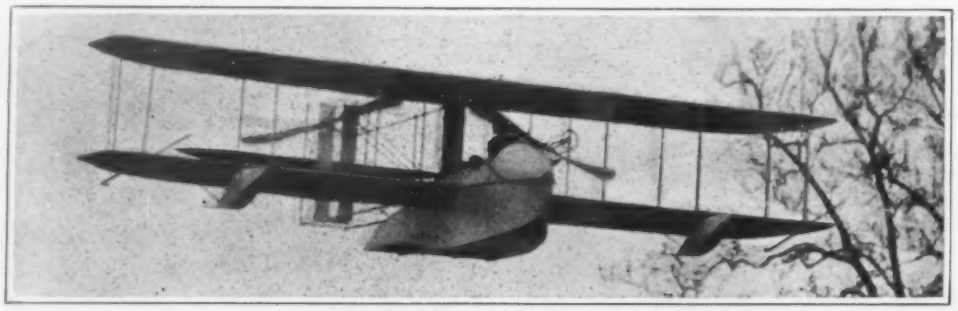


General view of the apparatus for the automatic transmission and reception of wireless messages.

A New American Flying Boat

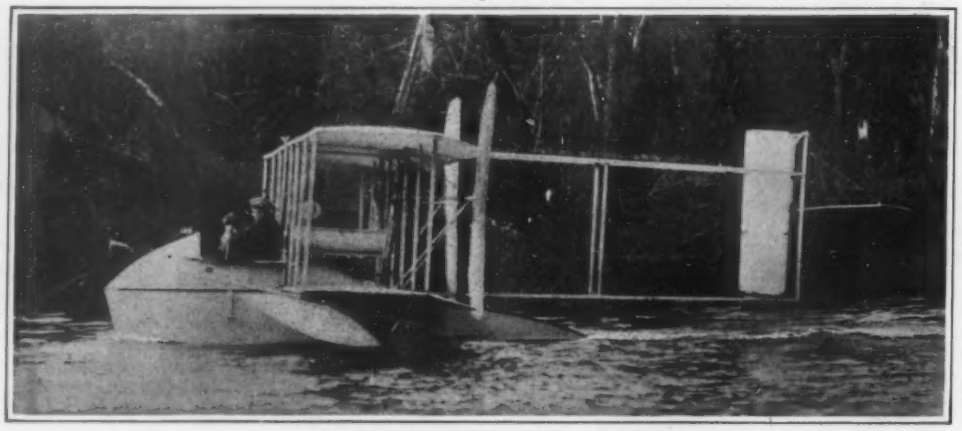
DURING the past summer Mr. Orville Wright has been experimenting with a new hydro-aeroplane of the flying boat type, and he has recently brought out a machine which will undoubtedly find favor with all sportsmen interested in aviation.

The first Wright hydro-aeroplane, it will be remembered, was of the twin float type, and was built for Mr. Russel A. Alger and flown for him by Aviator Frank Coffyn. Even today this aviator prefers the pontoon type of hydro-aeroplane, as the operator is not in a tight place in case the machine dives into the water, and also because he believes it to be more seaworthy. After experimenting with this type for some time, however, Mr. Wright, aided by Grover C. Loening, the author of "Monoplanes and Biplanes" and the present superintendent of the Wright factory, has evolved the new flying boat shown in the accompanying illustrations.



FRONT VIEW OF WRIGHT FLYING BOAT IN ACTION.

Note the peculiar tapered stern behind the step, and the small floats beneath the lower plane.



SIDE VIEW OF THE FLYING BOAT GATHERING HEADWAY.

Note the location of the men and motor, and the clearance between the ends of propellers and surface of the water.

A new twin-propellered hydro-aeroplane.

The new Wright flying boat is different in several respects from the Curtiss and from those which are copies of it. A small Wright biplane is mounted low down on top of a hydroplane hull and contains the motor on its lower plane much as in the ordinary land machine. Instead of having a long upwardly slanting, tapered stern or tail, this hull, which has a single step about in the middle, tapers down to the water about half way back to the rudders of the aeroplane. These are supported on the usual four outriggers used

(Concluded on page 462.)

Catalepsy in Insects

Experiments Showing How Insects Pass Periodically into a Trance

By Percy Collins

RECENT experiments with a species of Phasmid, conducted by Peter Schmidt, Privat Dozent of the Imperial University of St. Petersburg, have brought to light the astonishing fact that these insects pass periodically into a state of catalepsy or trance. The species in question (*Carausuis morosus*) is a native of Northern India and Afghanistan, but for some years past it has been bred extensively in the laboratories of Europe. It is exceedingly prolific, and is thus well adapted for purposes of experiment. In common with most other *Phasmidæ*, its form is slender and stem-like, according in a remarkable manner with the twigs and branches of the plants upon the leaves of which it feeds. Its habits are almost exclusively nocturnal. During the daytime it rests motionless in a characteristic attitude —the fore legs being brought close together and extended in a line with the body. In this pose its stick-like form and green color combine to vest it with a most perfect concealing resemblance to its surroundings.

In the past, the long hours which this and certain other insects pass without evincing the slightest sign of animation have been regarded as periods of normal slumber, or as due to instinctive promptings calculated to enhance the protective value of the creature's physical endowments—such as its shape and coloration. But Schmidt has demonstrated that the quiescent condition —at least in the case of *Carausuis*—is the outcome of catalepsy. All his experiments have shown that the muscles of the insect are in that state which physiologists term *flexibilitas cerea*, i. e., wax-like flexibility. They are strained, but not extremely so, and if they are further stretched, they remain in the new position. Exactly the same state of the muscles is observed in the case of catalepsy or "hypnosis" in the higher animals, and in mankind.

Schmidt found that he was able to arrange the Phasmids, when in a cataleptic state, in uncouth and abnormal poses, and that they would subsequently remain absolutely motionless for long periods of time. For example, he placed some on their heads, and they remained thus for as long as four and a half hours. Others were poised bridge-wise between two books, the middle area of the body being weighted by means of paper slips to such an extent that the whole insect became bow-shaped. Even more remarkable was the posture which Schmidt designates the "wrestling bridge." This, as well as numerous other strange attitudes were maintained by the Phasmids for one or more hours; nor was it possible to detect the slightest sign of fatigue or even of vitality. Finally, some of the insects were subjected to the ordeal of mutilation; and it was found that their legs, antennæ and heads might be cut off, and their bodies sliced into fragments, without disturbing their death-like slumber. Schmidt points out that these results are entirely in accord with what we know of cataleptic phenomena in general, viz., that the subject does not feel pain, and that the muscles are not susceptible of fatigue. He also emphasizes the fact that the cataleptic state in Phasmids arises naturally, and from unknown *inner* causes. When in an active condition, the insects cannot be hypnotized artificially, as can be done with rabbits, crayfish, etc. For this reason he calls the phenomenon "autocatalepsy." He adds that from a biological standpoint the cataleptic state may be regarded as an accommodation to a highly developed protective resemblance. The insect becomes in no small degree a part of its environment, and completely subject to external factors. It is, for example, swayed by the wind, just as if it were really one of the stems among which it rests.

In order to awaken these Phasmids from their hypnotic slumber, prolonged excitation of the nervous system is needed. This may be effected mechanically by pinching the extremity of the abdomen with forceps, or by electric shocks from an induction coil. It is noticeable, however, that the stimulus must be very strong or long continued to be effective. In normal circumstances the insects regain animation at the hour of twilight, probably as the result of stimuli connected with the processes of nutrition, though of this nothing is certainly known.

In conclusion it remains to be said that the remarkable results which have attended Schmidt's experiments should induce many students to undertake similar investigations. If one species of Phasmid is subject to cataleptic seizures, then in all probability other species will be found to exhibit like phenomena. Moreover, it may well be found that the protracted periods of quiescence which many insects periodically sustain are really instances of catalepsy. This may be the case, for example, with the strange, stick-like caterpillars of the geometrid moths whose habits resemble so closely those of the *Phasmidæ*. Again, it has already been shown experimentally that a pin may be passed through the body of a sleeping moth without awakening it. Surely this suggests that the insect is not merely reposing, but rather that it is in a cataleptic seizure.

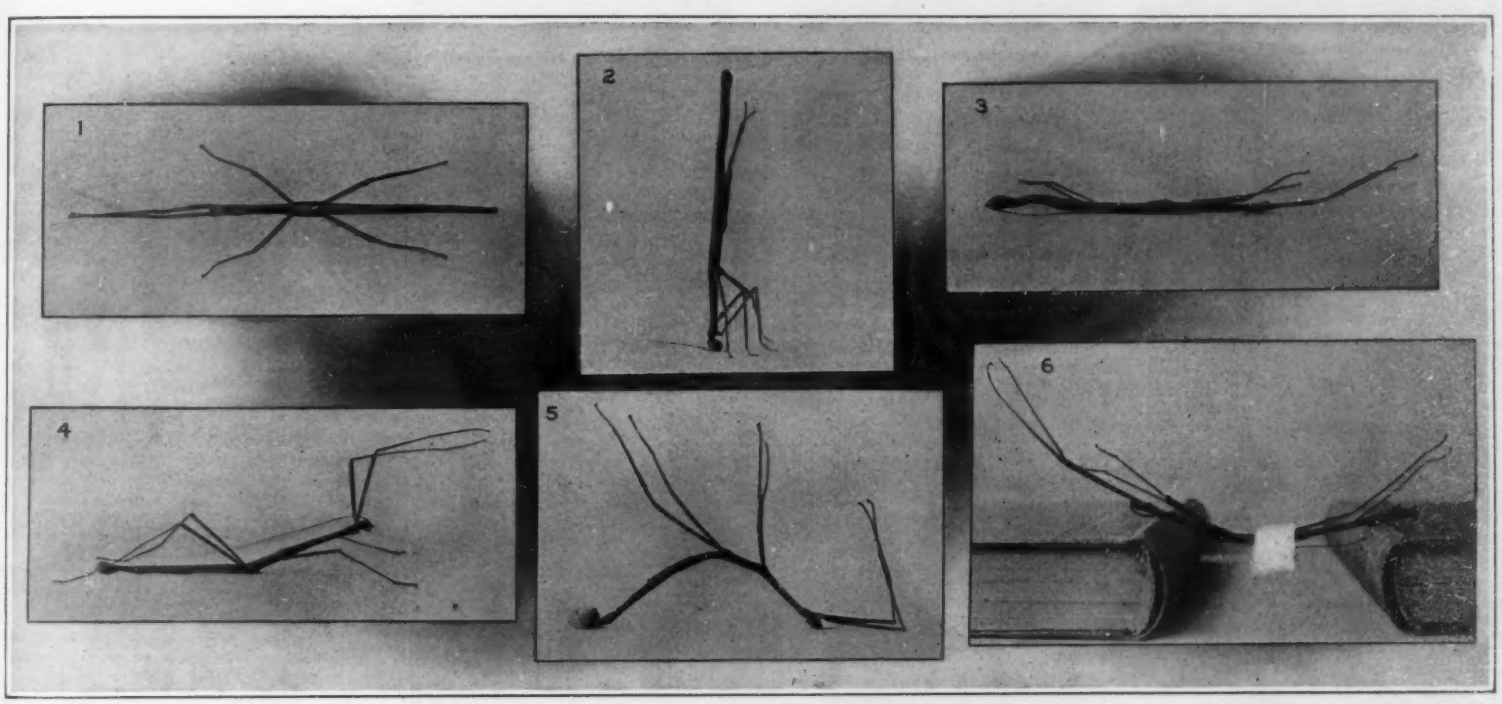


Fig. 1.—Normal resting attitude of the insect *Carausuis*. Fig. 2.—Standing on its head. Fig. 3.—Extended on its back. Fig. 4.—Nautis, or seahorse-like pose. Fig. 5.—What Prof. Schmidt calls the wrestling "bridge." Body bent and supported by small stone. Fig. 6.—Insect as bridge between two books. Its body weighted by means of paper slips.

Catalepsy in insects.

The Progress of Eugenics

DURING the past twenty-seven months more than 2,400 persons have exchanged letters with the Eugenics Record Office of Cold Spring Harbor, N. Y., on matters concerning some phase of eugenical studies. Up to January 20th, 1913, there were ten thousand and fifty surname trait cards in the files of the office. These are for use in locating all persons of the same surname with the same trait—as for example, all the Smiths with Huntington's Chorea. There were also 10,050 trait-surname cards in the files. These enabled the students to find all the data in the office on a given trait, classified according to surnames (the maiden names of married women are always used when available). There are now 8,655 trait-locality cards. These enable one to locate readily all the data in the files of the office on mechanical geniuses in Connecticut, or any town or city in that State, or on feeble-mindedness in Rockland County, New York, and so on. There are also 8,655 locality-trait cards, which collection performs, as its name indicates, the function of tracing the history of traits possessed by the families of a given locality. It is a sort of inventory of the blood of the community. Then there are the surname locality cards, and the locality-surname cards both numbering 8,150. The first constitutes a directory of the geographical distribution of a given family and the second serves as a directory of family names of a given community.

On January 22nd, 1913, there were on file in the Eugenics Record Office seventy-seven requests in which intelligent persons asked for instructions for making a study of the eugenical fitness of a contemplated marriage, all of which letters were received within a space of four months.

Of late the subject of eugenics has become a popular one for newspaper discussion. Unfortunately the American reporter does not trouble himself to find out the truth concerning the aims and methods of eugenical study. Anything even remotely related to sex hygiene, infant mortality, birthmarks, baby culture, sex control, prenatal influence, or to the care, "cure" or treatment of defectives, is given a heading entitled "eugenics"—this or that. Some day they will learn that it is only one of the sciences devoted to the promotion of human welfare. Eugenics is no more concerned with defectives than with genius. Both are legitimate objects of eugenical study. Eugenics does not seek to undo or to modify one's traits—that is a task for the educator—but it does seek to prevent in the future eugenically unfit matings. It is not—as one paper recently called it—"the latest social upheaval." It does not propose to undermine the existing social and moral order, or to destroy love, but its programme does call for the eugenical education of the intelligent classes and for the intelligent management of defectives.

Funds for the Mawson Expedition are now probably sufficient to complete its work and bring the explorers home, the Commonwealth of Australia having just added £5,000 to its previous donations. The press report recently published to the effect that Mawson and his companions had been brought away from Adelie Land was erroneous.

Motor Roller Skates

ONE of the interesting novelties to be seen at the recent electrical show at the Grand Central Palace, New York, was a pair of motor roller skates, adapted to be driven by electricity obtained from a battery carried by the wearer of the skates. The inventor of this machine demonstrated the practicability of the skates by making exhibition runs around the building and also on the sidewalks outside. As shown clearly in the photograph, each skate is provided with an extension to the rear, on which is supported a small two-pole motor. The armature shaft carries a sprocket pinion, which is connected by chain to a sprocket wheel on the rear roller axle of the skate. The motors may be connected to one or both cells of the battery as desired by means of flexible wiring. Our illustration shows the two cells of battery supported by a strap running over the skater's shoulders. However, in the preferred form the battery is strapped to the back of the skater. Current to the motors is controlled by two button switches, one for each motor, so that the skater may conserve his battery by cutting out one or the other skate, depending upon which is idle. It will be understood of course that the skater may merely stand on the skates, letting them be propelled by the motors, or he may skate on them in the ordinary way, using the motors to give him a much greater speed.

Electrically driven roller skates.

How the motor is mounted.

A Convertible Touring Car Tractor

IN the present enlightened age, agricultural tractors are comparatively common and they bid fair to be still more common in the not far distant future. Also, ordinary touring cars are very common, though it is very seldom indeed that one encounters a vehicle in which the cardinal features of both are combined. Manifestly, it is not easy to combine a touring car and a farm tractor in one vehicle and to do so without sacrificing the advantages of either in its respective sphere. And yet that is exactly what has been done by a western manufacturer, and the result is shown by the accompanying illustration.

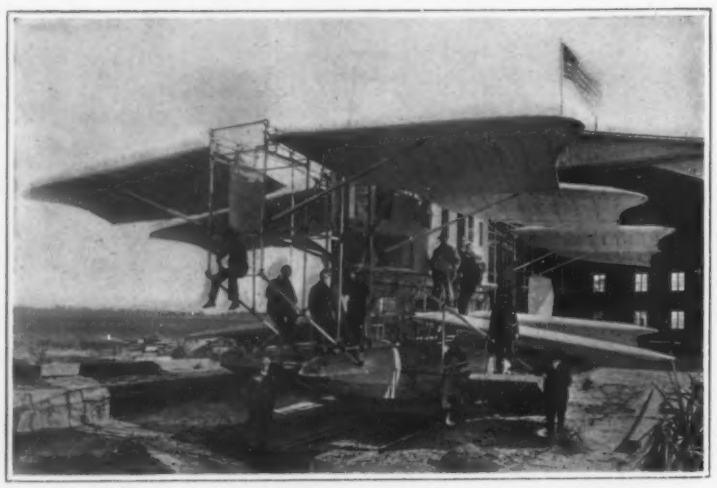
The car, it may be seen, is an ordinary every day touring car—when the great tractor wheels are left off, of course. The only alteration in it that has been made consists of the addition of a pair of spur gears to the hubs of the driving wheels. These spur gears mesh with much larger gears on the tractor wheels, and with the automobile in "high gear" and a single reduction at the tractor wheels, the speed of the machine is four miles an hour; there is a second speed reduction, for heavier hauling, which gives a maximum speed of only two miles an hour. The whole tractor mechanism is quite separate and distinct from the automobile proper and is merely bolted in place when the farmer desires to convert his pleasure vehicle into a working vehicle. Because of the slow rate of progress and the heavy work imposed on the engine, an auxiliary water tank, to insure proper cooling of the cylinders, is carried. A power shaft for stationary work also is provided.

This novel touring car tractor is designed to draw, and actually does draw, three sixteen inch plows in soft or wet ground, and, it has been estimated, replaces from six to nine horses.

A motor car converted into a tractor.

Protecting Store Windows from the Shock of Blasting

IN excavating for the new subway running up Lexington Avenue, New York, a large quantity of rock has had to be blasted. The shock of the dynamite explosions has worked havoc with plate-glass store windows along the line, and the contractors have found it necessary to reinforce the windows. This has been done in a very effective way by the use of wooden supports on each side of the glass, which serve as spreaders for wires that run across the glass to opposite sides of the window frame. The spreaders consist of wooden crosses with a short mast or pin projecting from the junction of the cross. To provide a good bearing on the glass, each arm of the cross is shod with a strip of rubber. Usually four of the wooden crosses are used on a window, but the number and position depend upon the size of the pane. When the wires are stretched across, both inside and outside of the window, they convert the window pane into a truss which is greatly strengthened against the explosion waves.



A two and one half ton hydro-aeroplane built to fly across the ocean.

Store windows reinforced to protect them from the shock of blasting.

The "Egg" in the Giants Causeway

MANY of the readers of this article have visited that strange formation in the north of Ireland known as the Giants Causeway, so called on account of a legend that a Scotch giant boasted that, did he not have rheumatism, he would cross to Ireland and destroy the pretensions of a certain Irish giant. Erin's giant showed his disbelief in this by building a causeway so that his rival for pugilistic honors could come over without wetting his feet. The battle resulted in defeat for the visitor, whose boasting ceased, and the part of the causeway in the sea, now no longer needed, was destroyed. Up high in the cliff, past the part usually visited by tourists, is the "egg" pictured herewith. What part this had in the argument is unknown. It is a large round stone about two feet thick and four feet long, and is inclosed in a shell of material resembling lava. Around this shell is another of similar material. Part of both shells are broken away—probably by slides of rock—revealing the stone inclosed therein long ages ago.

The "egg" in the Giants Causeway.

An Aero Yacht

AN enormous flying machine has recently been completed at Dutch Island, near Savannah, Georgia, by Capt. Matthew A. Batson, United States Army, retired. The construction of the machine occupied seven months, and it cost $50,000. It weighs 5,000 pounds, and the inventor of it claims an additional lifting capacity of two tons. The machine is equipped with twelve large wing planes, one pair having a spread of 39½ feet, and four pair with a spread of 37½ feet, while a sixth pair has a spread of 30 feet. The wings are peculiarly designed with the purpose of guiding the air currents inwardly toward the body of the machine and there banking them under the base portion of the wings, which are concaved underneath and carried back along the chassis, so that the currents of air are conducted along the parts nearest the chassis. Any wing or set of four wings or all twelve may have their angle of incidence changed at the will of the pilot by the turn of a wheel while the machine is in full flight. The machine is equipped with three Emerson aeroplane engines, of six-cylinder type, installed in the floor of the pilot house. Combined, these engines will supply 350 horse-power, driving the propellers at 1,000 revolutions per minute. Any one of the engines may be thrown out of or into action by the operation of a clutch. The cabin of the machine is 27 feet long, and is constructed of cypress paneling ⅝ of an inch thick, over which is a covering of canvas. The lifeboat is made of three-ply cypress and ash with inter-layers of canvas. The length of the machine is 74 feet and of the boat 33 feet. It is by far the most elaborate hydro-aeroplane ever attempted. The inventor expects to fly across the Atlantic in this machine. We have yet to learn what it will do in flight.

A Mineral Prospecting Apparatus.—Benjamin Andrews of Houston, Texas, has secured a patent No. 1,071,199 for a mineral prospecting apparatus which includes a bit and a double drill stem formed of two concentric pipes, air being forced down through the outer and into the inner pipe with the lower end of the inner pipe open and disposed to receive the material removed by the bit so it can be forced up through the inner pipe by the current of air.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

CANE FRAME FOR CAPS AND HATS.—JOSEPH BUCHALTER, 133 Avenue D, New York, N. Y. The frame is for use for caps, hats and similar articles of head gear and arranged to render the article exceedingly light, to insure comfort to the wearer, to reinforce, and to render the same flexible with a view to permanently maintain the original shape of the article even if roughly used.

DRESS SHIELD.—LULU L. JUST, 950 Crosat, La Salle, Ill. This improvement provides a shield wherein an absorbent pad is provided, which may be easily removed for the purpose of laundry or replacement and which, because of the nature of the application of the pad, permits the use of a smaller and cooler shield and serves to protect the shield; and provides means for retaining the pad in position, dispensing with the use of auxiliary fastening devices.

ORNAMENT HOLDER FOR HATS.—A. P. BENNETT, 28 W. 127th St., New York, N. Y. This device can be easily secured to a hat and will quickly engage any desired ornament, such as a feather, ribbon, etc., at any angle, and such ornament can be easily disengaged to admit another when it is desired to use the same hat for a different social function. The holder can also engage more than one ornament at different times and at any desired angle to each other.

Pertaining to Aviation.

AIRSHIP.—C. E. MYERS, Frankfort, N. Y. The invention relates to airships and especially to such that employ gas bags to give buoyancy. It contemplates the use of an explosion engine for propelling the airship, and an object is to provide an arrangement whereby the exhaust gases from the engine pass into the gas bag to affect the buoyancy or equilibrium thereof.

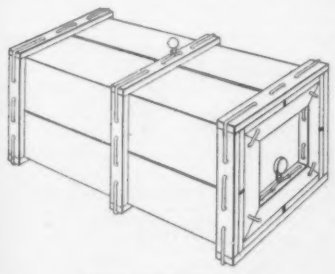
AEROPLANE.—H. C. WELL, care of H. C. Well Motor Co., Inc., 120 World Tower Bldg., 110 W. 40th St., New York, N. Y. This aeroplane has two planes with two pairs of auxiliary planes, one plane in each of the pairs of auxiliary planes being disposed above the other respectively, one pair of auxiliary planes being disposed in front of the main planes, which is termed the head, and the other pair of auxiliary planes being disposed in the rear being termed the tail, there being means which are adapted for moving the auxiliary planes simultaneously relatively to the main planes.

Electrical Devices.

APPARATUS FOR USE IN THE TREATMENT OF DEAFNESS.—A. ROSENBERG, 259 High Holborn, London, W. C., England. This invention is a division of Mr. Rosenberg's application which was patented March 25th, 1913, No. 1,057,279, and has for its object a device for the treatment of deafness and other disorders of the auditory organs by agitating the sound-conducting and sound-piercing portions of the ear by means of mechanical vibrations having a continuous undulatory character corresponding to that of the sounds (speech, music and the like) to which it is required to train the ear to respond.

Of General Interest.

WOODEN PACKING CASE.—B. JUSTIN, 742 Main St., W. Tampa, Fla. The invention relates to a packing case for general shipping purposes, and more especially to a case in which cleats are provided extending around the case, the cleats being provided with wires laced therethrough. The cleats cross the joints between the side boards at the several sides of

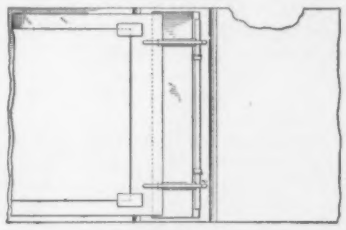


WOODEN PACKING CASE.

the case. The cleats are arranged at each end and intermediate the ends, and the wires of the end cleats are laced through said cleats, through the end frames of the case. An additional wire is laced through the end frames transversely through to the lacing of the cleats and the several wires are sealed in any approved manner.

CELLULAR DAM.—G. BLAAUW, 505 Pittsburgh Bank of Savings, Pittsburgh, Pa. The inventor provides a dam having a cellular or honey-comb structure in which the cells are of different lengths and controllable to some extent independently of one another, each cell having the double purpose of enabling water to be contained within the dam for the purpose of weighting the same down and of enabling a dam of large size to be constructed with a comparatively small quantity of the material employed.

BINDER.—C. E. SWIFT, 300 Harmon Ave., Danville, Ill. This invention has reference to loose leaf binders and is especially intended for use to produce a binder adapted to receive loose leaves consisting of cardboard or like

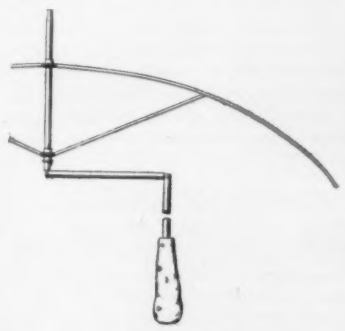


LOOSE LEAF BINDER.

mounts bearing blue prints on opposite sides. The improved binder and mounts has a capacity and form such that a large number of blue prints may be assembled in a single binder and accessible for convenient examination.

SANITARY HOLDER FOR BARBERS' CHECKS AND ACCESSORIES.—F. J. COX, care of Pioneer Barber Shop, Dodge City, Kan. An object here is to provide a holder for the use of barbers, adapted to hold checks of varying amounts, and in addition, to hold various accessories, such as tweezers, curlers, lather papers, and such materials as styptic powder, face cream, and an antiseptic preparation, a camphor preparation, or the like.

UMBRELLA.—M. GARRAU, Soriano, 1436 Montevideo, Uruguay. This invention relates to that class of umbrellas in which the rod is formed of pivoted sections so that the tip section carrying the umbrella when the latter



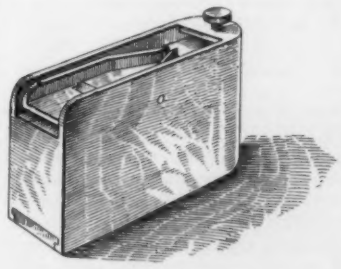
UMBRELLA.

is raised, will be offset at one side of the handle, parallel therewith. The illustration shows an elevation of an umbrella embodying this invention, the umbrella covering being omitted, and the tip section being adjusted in a position offset from the handle section.

Hardware and Tools.

LOCK.—A. S. FRANKS, 340 W. 19th St., Manhattan, N. Y., N. Y. The invention pertains to improvements in locks, and particularly to a locking structure operated by a magnet. The object is to provide a lock which may be readily operated from the interior at any time and which may be operated from an exterior or outside of the door by the magnet only.

PENCIL SHARPENER.—J. J. WOLF, 330 Nixon St., San Antonio, Tex. This invention provides for sharpening a pencil point by removing the wood therefrom in the form of

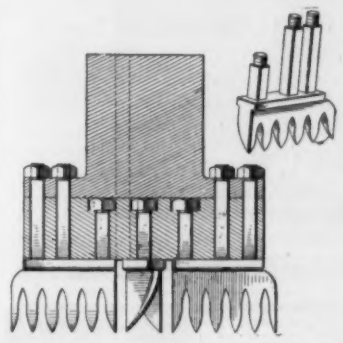


PENCIL SHARPENER.

shavings of different thicknesses; provides means for positioning the pencil preliminary to removing the shavings therefrom; provides means for varying the operation of the cutting member of the sharpener; provides means for collecting the dust and shavings independent of the operation of sharpening the pencil; and provides a structure transportable in the pocket.

SHUTTER HINGE LATCH.—F. O. LAWSON, Greenboro, N. C. The aim in this invention is to provide a mechanism in connection with the hinge of a shutter for holding the shutter locked in open position, and so arranged that while the latch may be disengaged manually, it will also be disengaged by the act of lifting the shutter prior to closing the same, that is, a latch so arranged that it may be released by relative movement of the leaves of the hinge with respect to each other.

DRILL.—F. R. WEATHERSBY, 312 Scanlan Bldg., Houston, Tex. The invention relates to drills for general use and more particularly to drills especially adapted for use in connection with rock and earth formations. The more particular purpose is to provide a drill in which there are a number of separate cut-



DRILL.

ters detachably secured upon a head. The various cutters are removable and replaceable independently of one another. In operation the parts being arranged and assembled, the shank is connected with the operating mechanism of the drill and being forced against the earth is caused to rotate. The cutters are thus caused to revolve, the teeth being brought into operative engagement with the earth, rock or other material to be cut.

Heating and Lighting.

PORTABLE ELECTRIC READING LAMP.—S. J. LEVI, T. A. ROSE, and A. H. ROSE, 38 and 39 Beech St., London, E. C., England. This invention has for its purpose the provision of a construction especially adapted for attachment to the cover or pages of books, magazines, and the like, or to the lapel of the coat of the user, so that the light can be thrown on to the pages of such books, magazines and the like, or in any desired direction.

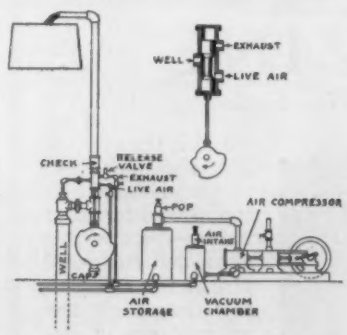
MEANS FOR CONTROLLING FUMES OR SMOKE.—G. E. WAGGONER, Vacaville, Cal. The invention has reference generally to means for controlling fumes or smoke, and more particularly it is adapted for co-operation with a smelter whereby gas, fumes and smoke emitted by the smelter may be controlled.

Household Utilities.

EGG BEATER.—T. HOLT, care of the Holt-Lyon Co., Tarrytown, N. Y. Among the principal objects of the invention are: To provide means, manually operative, for rotating suitable flukes; to eliminate friction in the operation of the apparatus; to reduce the space required for storage and transportation of the apparatus; and to simplify the construction and economize in the cost of the same.

Machines and Mechanical Devices.

APPARATUS FOR HOISTING LIQUIDS FROM WELLS.—D. D. MCCALL, care of South Texas Lumber Co., Houston, Tex. This invention relates to apparatus for raising liquid from wells by means of a compressed fluid, such as air or other vapors or gas, and refers more particularly to the class comprising a

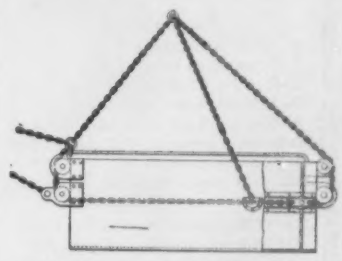


APPARATUS FOR HOISTING LIQUIDS FROM WELLS.

member carrying a compressed fluid, a member used as a cylinder for the liquid to be hoisted, and a member conveying said liquid to a desired place, together with means associated with the above members whereby the flow may be controlled.

SCALE.—I. CHARET, 552 Sutter Ave., Brooklyn, N. Y. The principal object here is to provide a scale head made up of a plurality of moving parts by which a sector is actuated whereby the deflection or moving of the said parts is indicated on a suitable scale, thereby evidencing the load on the platform of the scales. Mr. Charet has invented another scale, the principal object of which is to provide means of mounting the scale platform, the construction being characterised by the adjustability of the parts, whereby the fulcrum may be varied in order to vary the effects of different loads on indicating mechanism used therewith.

SELF-CLEANING DRAG SCRAPER BUCKET.—M. H. MONSE, care of John Wagner, Exchange Bank Bldg., 317 Carondelet St., New Orleans, La. The invention relates to excavating or dredging devices and has particular reference to the construction of buckets



SELF-CLEANING DRAG SCRAPER BUCKET.

or skips. Among the objects of this invention is to devise a bucket having means associated therewith for automatic operation whereby the contents of the bucket, if of a sticky nature, will be dragged or scraped therefrom at the dumping operation.

CLOCK WINDING DEVICE.—C. T. BERNHARDT, Box 544 Salisbury, N. C. In the present patent the object of the improvement is the provision of a clock-winding device in the form of a self-contained unit attachable to the spindle of the winding barrel of the clock, and bodily removable therefrom whenever desired.

Pertaining to Vehicles.

DEFLATING DEVICE.—W. F. SPRICK, Stickney, S. D. This device is for use with the air valves of pneumatic tires, wherein means is provided for opening the valve, and having means in connection therewith for gripping the threads of the valve casing to hold the valve open to permit the air to discharge therefrom.

BOLT FASTENING.—BELDIN C. SMITH, 779 Congress St., E. Detroit, Mich. This invention is a bolt provided with a lever lock or fastening for use in place of a nut, the same being adapted for general use as a substitute for threaded bolts and nuts and being particularly applicable for securing the bows of automobile tops in such manner that they may be very quickly and very easily located securely or detached.

VEHICLE TIRE.—R. L. LEACH, P. O. Box 18, Honolulu, Hawaii. This inventor provides a casing for a pneumatic tire, the surface whereof is impervious to puncture and the body whereof holds the pneumatic tube against undue or uncalculated inflation strains; and provides a simple, efficient and economical form of construction.

TRACTION WHEEL.—A. HUFFMAN, Mutual, Okla. This invention is for use with agricultural implements, traction engines and for like purposes, and refers more particularly to a traction wheel having a rim and a plurality of ground-engaging members associated therewith and adapted gravitationally to assume projected positions in advance or back of the point of contact between the wheel and the ground.

Designs.

DESIGN FOR A LAMP SHADE.—L. H. NASH, care of Tiffany Furnaces, Corona, N. Y., N. Y. In this ornamental design for a lamp shade the top and bottom are of a band-like formation, the material forming the body of the shade being of an uneven yet attractive pleated design.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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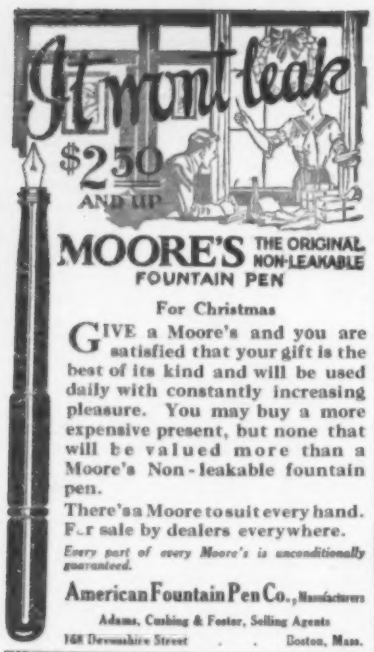

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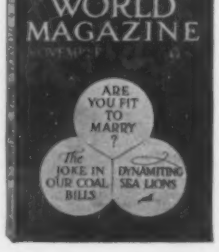

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YOU'LL LIKE IT

A New American Flying Boat

(*Concluded from page 458.*)

on the Wright biplanes, instead of being mounted on the extension of the hull as in most other flying boats. A special quadrangular tapered float is mounted beneath the boat about half way between the latter and the end of the plane, on each side. On the usual flying boat cylindrical floats are placed at the ends of the lower plane. The seats for the pilot and passengers are located in the hull just in front of the lower plane, and a superstructure is fitted giving the hull much the appearance of a cruising motor boat. A starting crank is arranged conveniently behind the pilot's seat, and the craft is equipped with an electric motor starter, muffler, anchor, whistle, and other fittings used on motor boats.

The power plant of this new boat consists of a 6-cylinder, 60 horse-power Wright aeronautical motor, which drives the twin propellers by the usual crossed chains. So efficient is the flying boat that a speed of quite sixty miles an hour has been attained with two people on board; and it rises from the water after traveling a distance of less than two hundred feet. The speed attained with 60 horse-power shows that the machine is more efficient than the usual type of flying boat in which a motor of from 80 to 100 horse-power is generally used. The machine has shown itself to be very stable in winds and to be readily steered and controlled, for Mr. Wright has frequently piloted it above the Miami and Mad rivers, which are narrow winding streams in the vicinity of Dayton.

Another point to be noticed about this new flying boat is the location of the seats high up in front where the spray does not strike the pilot or passengers, while the motor is well protected behind the latter. On account of the high freeboard and thorough covering of the hull, the boat should be able to live in a comparatively high sea.

Baalbek the Mysterious

(*Concluded from page 457.*)

on a raised platform resting on substructions. The Great Temple lies 44½ feet above the level of the plain and is the highest part of the entire inclosure, while the Great Court was only 23 feet lower down. An inclosing wall, the mammoth stones of which have been the marvel of engineers for ages, deserves mention. The lower courses of the wall here are built of stones of moderate dimensions, but they grow rapidly in size, until we come to a row of three enormous stones, the shortest being 63 feet and the longest 65 feet in length, each being about 13 feet high and 10 feet thick. The course of which they form part is some 20 feet above the surface of the ground. They are the largest building blocks ever known to have been used by man, and a still larger one lies in the ancient near-by quarry, never having been detached from the rock beneath. This one is 70 feet long, 14 feet high, and 13 feet wide. Its estimated weight is 1,100 tons, and it is calculated that to raise it would require the strength of 60,000 men. It was probably intended to be placed in the cyclopean wall of the temple inclosure, but some sudden war, pestilence, or revolution must have interrupted the plans of these ancient builders or they would not have expended the labor of years upon this mighty block and then abandoned it still unattached from the quarry.

Baalbek's third and last ruin is the pretty little Temple of Venus. It is situated some 200 yards from the other ruins. It is an exquisite Corinthian building, with gracefully decorated interior. Owing to the peculiar arrangement of the interior columns, it has the appearance of an octagon. The entablature supported by these columns does not run continuously from column to column, but recedes in a graceful curve almost to the wall of the cells, giving the whole an appearance of lightness and elegance rarely equaled. In the last century some attempts at renovation were made by the Greek Christians, who converted it into a church dedicated to St. Barbara. It is not now, however, used for worship, and has been rapidly

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falling into ruin. The German excavators, however, have strengthened many of its weak parts and cleared away some fifteen feet of rubbish so that to-day one obtains a better and a clearer view of this ancient temple.

The Manufacture of Hydrogen Gas

(Concluded from page 452.)

during this time the coke gases are carried off through the opened top cover and escape into the air through the plate iron chimney. The blast is now stopped and the top cover closed down, whereupon the oil spray is set working, and the oil is transformed into oil gas, this being obliged to pass through the heated coke of the two generators in succession. In this way all the light as well as heavy hydrocarbons are decomposed and the result is a high grade of hydrogen gas containing from 90 to 96 per cent pure hydrogen. Before the producer is actually working to deliver the pure gas to the rest of the apparatus, care is taken to evacuate the gas which was already contained within the producers, and the first part of the newly-produced hydrogen is allowed to escape by way of a special valve which is fitted on for this purpose, according to a patented method. During the usual working of the producers, the passage of the gases through the hot mass of coke causes the temperature of the coke to become eventually lowered, and when it cools down below a certain point there will be no more gas generated. When this is the case, the oil feed is stopped and the hot air blast again turned on so as to fire up the coke mass as was done in the first place. Then the oil spray is turned on and the process repeated. Thus the method is an intermittent one, and consists in an alternate operation of the oil spray and hot blast. Firing up the coke by the blast usually takes 2 or 3 minutes during the run, that is, when the coke is still hot, then the gas production lasts for about 20 minutes, and so on.

From the second producer the gas goes by good-sized piping into a device which is provided with a water seal (shown in the first engraving) in order to prevent a back flow of gas during the period when the hot air blast goes through the producer. Care is taken in all cases to keep the hydrogen from becoming mixed with air, as is of course quite essential. The gas then passes into the second car by means of coupled piping. On the front end of the car is mounted a well-designed scrubber which is designed with water flow so as to clear the gas of all mechanical impurities such as ash or soot. The scrubber consists of a plate iron case which is filled up with the washing elements of patented makeup, a water flow being introduced at the top, while the gas comes in at the bottom of the scrubber. Means are provided for effectively dividing up the gas flow in small streams so that it comes into as good contact as possible with the water.

Next the gas comes into a cleaner which works on a dry process shown in the illustration, and it is designed to remove any sulphur compounds contained in the gas. Here the cells of the cleaner are filled up with a suitable compound which acts as a filter for the gas. For some uses of the hydrogen, the purifying process can stop at this point, as the gas is sufficiently pure for many industrial uses as may be seen by the following analysis: CO_2, 0.0 per cent; O, 0.0; CO, 2.7; CH_4, 0.0; H, 96.0; N, 1.3. The specific gravity of the gas is about 0.10. For such purposes it is not necessary to free the gas from carbon oxide or nitrogen. Next the gas is freed from moisture by sending it through a sulphuric acid dryer pictured in the small engraving and mounted after the other two devices upon the car platform. Last comes a heating furnace for removing the carbon oxide, the furnace being heated by oil gas. Then the gas goes to a cooler, which is built together with the first-mentioned scrubber. Analysis is then as follows: CO_2, O, $CH_4 = 0.0$; $CO = 0.4$ per cent; $H = 98.4$; $N = 1.2$. Sp. gr. $= 0.087$ to 0.092.

Firing up takes 1 to 2 hours, and the plant can run for months at a time, needing but two men. The plant follows the airship and either supplies it direct, or where too far off, by a special outfit provided with steel gas bottles. To this end a third car can contain a compressor plant for charging the bottles. In any case these need not be carried to any very great distance in order to reach the airship.

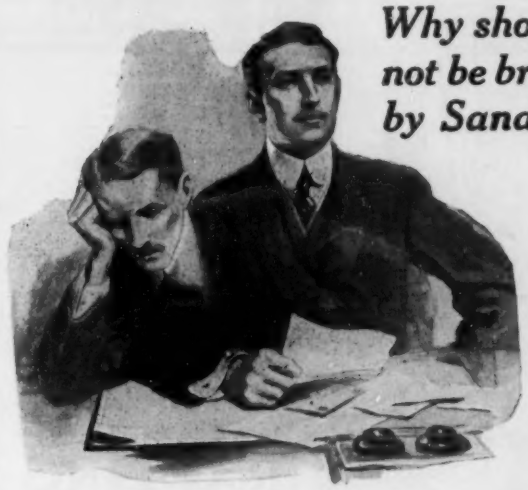
Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12874) H. H. asks: Would a body weigh more at the earth's surface than say 2,000 miles from the center, or less? It seems to me it should weigh more 2,000 miles from the center than at the surface by Newton's law and the following statement, which appears in the International Encyclopedia: "If a body is homogeneous throughout, its mass may be considered as concentrated at the center." A. A body has its greatest weight at the surface of the earth. Its weight diminishes as it is carried above or below the surface of the earth. The weight above the surface of the earth diminishes in the inverse ratio of the squares of the distances from the center of the earth. Below the surface of the earth the weight diminishes directly as the distance from the center of the earth. Thus at 4,000 miles above the surface of the earth, which is 8,000 miles from the center, or twice the distance of the surface from the center in round numbers, the weight is but one quarter as much as at the surface. Twice the distance, one-quarter of the surface weight. But at 2,000 miles from the center of the earth, which is 2,000 miles below the surface, or half way to the center in round numbers, a body will weigh half as much as at the surface of the earth. This assumes that the earth is of the same density everywhere as at the surface. It is explained as follows: A body at 2,000 miles from the center of the earth is on the outside of a sphere whose radius is 2,000 miles. The rest of the earth at a greater distance from the center than 2,000 miles ceases to have any effect upon its weight. In this sphere of 2,000 miles radius there is one eighth as much matter as in the whole earth, and for this reason the ball would be attracted and would weigh one eighth as much, but as it is half as far from the center it would for that reason weigh four times as much as on the surface of the earth, and four times an eighth is a half, so that a body half way down to the center of the earth weighs half as much as at the surface, if the earth is of a uniform density. Your statement that the mass of a body may be considered as concentrated at the center requires the qualification that its attraction upon another body outside of itself is as if its matter were concentrated at its center. At the center of the earth a body has no weight because all the matter of the earth is outside of it and cannot exert any attraction upon it. A body anywhere within a spherical shell has no weight. A body at the center of the earth is in effect in such a position.

(12875) C. W. B. asks: In a "science" article in a recent Sunday paper the writer said that if a stratum of air could be carried to the bottom of the ocean the pressure of the water would be so great that it would condense the air so it would be heavier and more solid than the water, and it would thus remain there, the water floating over it as if it was a solid. Now I supposed there was some air in the water of the ocean at all depths. Hence if a stratum was at the bottom, as suggested by that writer, it would soon be "absorbed" by the water, and all above the normal amount would eventually rise and escape at the surface. Which is right? A. Water is about 800 times as dense as the air at the surface of the ocean. If air could be carried to the bottom of the sea it would be compressed about 900 times and would then be much denser than water, so that it would not rise again to the surface. But it is obviously impossible to carry air down to the bottom of the sea, open to the pressure of the water. The statement which you quote says "if it could be carried." There is a very big "if" in it. What you say regarding the statement is also very true. You also have an "if" in yours. If air were at the bottom of the sea it would still be dissolved, not absorbed, in the water as it is at the surface, and so would gradually disappear. Both statements are correct.

(12876) C. C. S. asks: It is said that the solar constant is about 3 small calories a minute per square centimeter, or 30 large calories a minute per square meter. How may this be determined? A. The method of determining the solar constant is very simple in theory and very difficult in practice. The sun is allowed to shine upon a metal vessel, and the rise of temperature of the water it contains is determined for a given time. Probably the best work in this line has been done by Dr. C. G. Abbott of the Astrophysical Observatory of the Carnegie Institution in Washington, D. C., with his silver disk pyrheliometer, which does not employ water. If you are interested in this work you can obtain the report of it from the Smithsonian Institution. The latest work seems to show that the heat of the sun is not constant.



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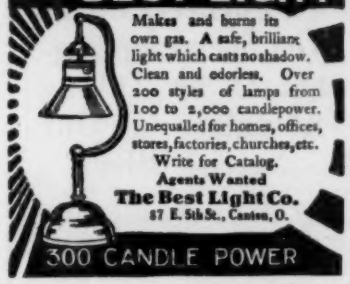

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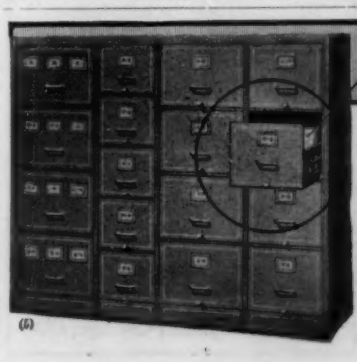

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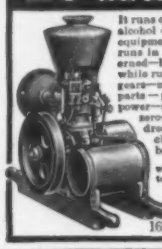

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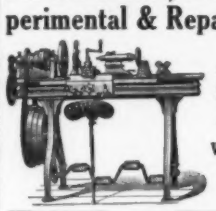

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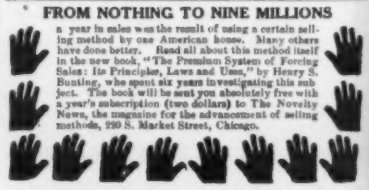

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THE INFLUENCE OF MONARCHS. Steps in a New Science of History. By Frederick Adams Woods, M.D. New York: The Macmillan Company, 1913. 8vo.; 422 pp. Price, $2 net.

As the title and sub-title, taken together, indicate, this is an attempt to appraise the value of the dynastic factor in the ebb and flow of national progress and the rise and fall of civilizations. The result of the author's years of research has been to confirm him in his belief that the political and economic progress of a nation has been very largely determined by the strength of character of the monarch under which such advancement was made. And Dr. Woods is strong in the conviction that it is a case of strong individuality molding its environment, rather than of conditions producing the man. The appendix of the work consists of a tabulation presenting the conditions prevailing, at different periods, in the fourteen European countries which are taken as the subject of comparative study. These conditions are set against the mental and physical characteristics of the ruler of the period, and the parallels furnish some striking examples for reflection. Whether we can affirm, with the author, that the master key of history is heredity, and then follow him to the extent of holding the heredity of the reigning monarch responsible for national prosperity or disaster, or not, certain it is that we shall profit by the stimulating outlook and the careful research and summarizing of a fascinating volume.

AN ELEMENTARY TREATISE ON CALCULUS. A Text Book for Colleges and Technical Schools. By William S. Franklin, Barry MacNutt, and Rollin L. Charles, of Lehigh University. South Bethlehem, Pa.: Published by the Authors, 1913.

The writers of this text have endeavored to develop their subject in the simplest possible manner, in order that the student may come as quickly as possible to a clear understanding of the principles involved. To break the course of the explanation by the introduction of exterior algebraic developments and frequent groups of purely formal problems is by them stigmatized as an "almost universal and really hideous feature." Such material is in the present work relegated to an appendix.

SCHOOL HYGIENE. By Fletcher B. Dresslar, Ph.D. New York: The Macmillan Company, 1913. 8vo.; 369 pp.; illustrated. Price, $1.25 net.

In a well-arranged text, a specialist in school hygiene and sanitation, of the United States Bureau of Education, sets forth the most important hygienic requirements of school life, and tells just how these requirements may be most efficiently and economically put into practice Its simple language and the evident wisdom of what it advocates will appeal to the busy teacher. Aside from the fundamental consideration of school location, construction, and lighting, there is much that the teacher can follow in the way of ventilation, heat-regulation, exercise, and, perhaps most important of all, such arrangement of work as to avoid undue fatigue.

MIDGET PROBLEMS. All the Ideas in Positions of 2 vs. 2 Pieces in Checkers. By William Timothy Call. Brooklyn, N. Y.: W. T. Call, 1913. 16mo.; 71 pp.; illustrated. Price, 50 cents.

Checker players, and all who take an interest in kinks and catches, will appreciate the positions and moves for which the author has ransacked all records. There is probably no game of which a superficial knowledge is more easily acquired than checkers, yet it is capable of a profundity of which the average player is entirely ignorant. Mr. Call has arranged his material in groups by themes, thus adding to the value of his study.

COMMON BATTERY TELEPHONY SIMPLIFIED. A Book for Practical Telephone Men and Students. By Walter Atkins. New York: The D. Van Nostrand Company. 12mo.; 164 pp.; 150 diagram illustrations. Price, $1.25 net.

The monograph assumes a knowledge of fundamental principles, offering a condensed but clear exposition of modern telephony to the practical man. The description of exchange working is based largely upon that known as the 24-volt system, which is the system in general use by the British Post Office.

TWENTY-EIGHTH ANNUAL REPORT OF THE BUREAU OF AMERICAN ETHNOLOGY. 1906-1907. Washington: Government Printing Office, 1912. 8vo.; 308 pp.; illustrated.

The report of the Chief, W. H. Holmes, chronicles the work and conditions of the Bureau in the fullest manner. During the year covered by this report, researches were carried on in New Mexico, Arizona, Oklahoma, Louisiana, Mississippi, Florida, New York, and Ontario. It will surprise most people to learn of the astonishing amount of work accomplished by the ethnologists, philologists, and clerical force of the Bureau, and its findings and accomplishments, though not lending themselves to the summary of a short review, are worthy of the closest attention.

EINHEIMISCHE FISCHE. Von Dr. K. Floericke. Stuttgart: Kosmos Gesellschaft der Naturfreunde, 1913.

Dr. Floericke has written a very instructive and entertaining little book on middle European fishes. Since many of these speci s and varieties are to be found in this country, his excellent presentation of the subject should be read with interest by those who are familiar with the German language.

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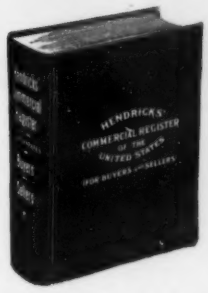

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